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ACALA COTTON
A SUPERIOR UPLAND VARIETY FROM SOUTHERN MEXICO

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CONTENTS

	Page
Origin and status of the variety	1
Supplies of Acala seed	3
Production in pure-seed communities	4
Searching for weevil-resistant varieties	6
Discovery of a superior type	7
Seed obtained at Acala, Mexico	8
Acclimatization of Acala cotton	10
Characters of Acala cotton	11
Cultural advantages of Acala cotton	13
Marketing advantages of Acala cotton	15
Classing simplified by production from pure seed	17
Acala cotton in California	17
Acala cotton in Arizona	19
Acala cotton in Texas and New Mexico	20
Type selection of Acala cotton	21
Diversity in Acala cotton	22
A narrow-leaf selection of Acala cotton	23
Ginning precautions with Acala cotton	24
Establishing seed supplies	25
Summary	27
Literature cited	28

ORIGIN AND STATUS OF THE VARIETY

Acala cotton is a superior variety of the upland species, *Gossypium hirsutum*. It is very early and productive, has fiber of excellent quality, and is adapted for cultivation over a large part of the American Cotton Belt. The variety has been utilized chiefly in the Southwestern States because in that region stocks of pure seed are maintained and communities are organized to grow only one variety of cotton. Utilization of the Acala variety by the same community methods in the other producing regions would make possible a general improvement of the cotton crop.

The production of a superior quality of fiber would afford the best assurance of establishing good prices for American cotton and avoiding the danger of foreign competition. Cotton of less than 1-inch staple need not be grown in any part of the United States. Superior varieties are available that are as early and productive as short-linted varieties. Larger yields can be obtained as well as fiber of better and more uniform quality by planting good seed. The production of needlessly inferior fiber is a waste of the resources of production, as well as a handicap to the textile industry.

The Acala variety is distinct from any of the varieties of American upland cotton previously known. It was developed from a native cotton of southern Mexico, discovered in 1906 in the central plateau region of the State of Chiapas. The first experimental plantings of the imported seed stocks were made in Texas in 1907, for acclimatization and breeding, and the first field planting of a select stock was at Waco, Tex., in 1911. Seed was distributed in 1920, and many favorable reports were received, but the system of seed distribution has been discontinued. Experience has shown that varieties of cotton are not established in cultivation by distributing small quantities of seed, which are soon mixed with other varieties.

In its plant characters the Acala cotton somewhat resembles Durango, a variety obtained from the tablelands of northern Mexico a few years before the Acala was discovered. Durango was well adapted to conditions in the irrigated valleys, and was grown extensively for several years in California, Arizona, and New Mexico, but later gave place to Acala, which proved to be even better adapted for cultivation in the hot irrigated valleys. The Durango was also grown successfully in the eastern Cotton Belt, in southern Virginia, and in western Tennessee, as well as in South Carolina, Alabama, Mississippi, and Texas, but the Acala variety has an even wider range of adaptability to local conditions.

The ability of these varieties to grow normally and to produce larger crops and better fiber than the local varieties of the different regions shows that good varieties of cotton are not necessarily restricted to particular areas. The experiments that have been conducted with the Durango and Acala varieties cover the range of conditions of cotton cultivation in the United States from the sea-beach sands around Norfolk, Va., and the Sea Islands of South Carolina to the various loams and clays of the Piedmont sections of North Carolina and South Carolina, the rich river-bottom and prairie black lands of the Mississippi Valley and Texas, and the very diversified soils and climates of the irrigated valleys of the Southwestern States.

The greater resistance of Acala cotton to high temperatures and adverse soil conditions has been shown in many comparisons with other varieties, including the Texas big-boll type, represented by Mebane, Lone Star, and Rowden. All the more prominent eastern varieties were tested and were found to be less resistant to extreme conditions than were the varieties from Texas and Mexico.

In the higher altitudes and along the northern rim of the Cotton Belt in the Eastern States, the range of cotton cultivation is extended by the single-stalk or thick-spacing method. Leaving the plants closer together in the rows yields larger crops under short-season conditions. The upright habits of growth of Acala cotton render it well adapted to the close-spacing method.

Many cotton growers of the southwestern valleys came from Texas and had a strong preference for the home varieties, but the results of repeated tests and of several years of practical experience in different districts have shown the superiority of Acala in larger yields and better quality of fiber. The Acala staple, under favorable conditions, has a length of $1\frac{1}{8}$ to $1\frac{3}{16}$ inches, and usually can be sold at a premium ranging from 2 to 5 cents a pound above the shorter staples produced formerly in the same districts. Very large yields were obtained in some of the early plantings of Acala cotton in California, and these attracted the attention of growers.

Most of the cotton now being grown in California and in the irrigated valleys of Arizona, New Mexico, and western Texas is of the Acala variety. About 400,000 acres of Acala cotton were planted in these districts in 1925. A much larger acreage of Acala might be estimated by including northern Texas, Oklahoma, and adjacent States, but definite figures are not obtainable, and much of the seed is so badly mixed that it should not be considered as representing this variety.

SUPPLIES OF ACALA SEED

It is only in the western irrigated valleys that provision has been made for the production of pure seed of Acala cotton in sufficient quantities so that all the growers can be supplied. Districts have been established where Acala cotton is grown exclusively, so that there is no mixing of seed or crossing with other varieties. A pure-seed association was formed among growers of Acala cotton in the Coachella Valley in southern California, in a district that was completely isolated and where most of the cotton is grown by the landowners rather than by tenants. The members agreed to plant no other variety of cotton and to have all of the pure seed handled through the association for a period of five years. The pure-seed organization has been maintained in the Coachella Valley since 1920. All of the farmers of this valley are supplied with pure seed at oil-mill prices plus handling costs. Additional stocks of seed are held for sale in other communities at low prices, thus making it possible to extend the use of the variety.

Pure seed is appreciated in California because it is recognized from experience with citrus fruits and other special crops that a uniform high-quality product must be maintained in order to establish an effective marketing system and make production profitable. In Riverside and Kern Counties the local boards of supervisors passed ordinances to protect the cotton growers who had organized one-variety communities, and when the legality of such ordinances was questioned the State Legislature of California passed a special act for nine counties of California recognized as pure-seed districts in which Acala cotton could be grown, and the bringing in or planting of other varieties was declared a misdemeanor (*2*).[1]

No detailed account of the Acala cotton has been published, since there is little object in bringing a variety of cotton to the attention of the public unless supplies of pure seed are available. In the absence of seed supplies, the usual effect of popularizing a variety of cotton is to stimulate the sale of mixed or misnamed seed, so that growers are disappointed and the variety is soon discredited and discarded. If seed of good quality is not obtainable in practical quantities, even the best variety could not become widely known and appreciated.

The prospect of a general improvement of the cotton crop by planting better varieties depends upon the solution of the problem of seed supplies, in order to preserve and utilize good varieties. Many good varieties have been bred, but few have been utilized, for lack of adequate stocks of good seed. Most of the seed that is planted is of inferior mixed quality, and the crop is irregular. The mixture of seed is greater with modern gin equipment than with the old plantation gins (*1*). Manufacturers complain that the quality of cotton is deteriorating instead of improving. Obviously, little is accomplished by adding to the number of varieties if the system of production is not changed so that good varieties can be utilized. No matter how good a variety may be, the same deterioration results if seed stocks are not maintained (*17*).

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[1] Italic numbers in parentheses refer to "Literature cited," pp. 28, 29.

The usual history of cotton varieties has already been repeated with the Acala. As a new variety, it attracted very favorable attention and became rather widely popular within a few seasons, especially in northern Texas, Oklahoma, and Arkansas. The demand for seed completely outran the supply, and badly mixed seed, some of it producing only a small proportion of true Acala plants, was sold as Acala seed. It is only in California that regular supplies of good Acala seed have been maintained, entirely separate from other varieties, in communities that grow no other kind of cotton. Other Acala communities exist or are being established in Arizona, New Mexico, Texas, Oklahoma, and North Carolina, but it is more difficult in the older regions of the Cotton Belt to effect a complete separation of varieties.

PRODUCTION IN PURE-SEED COMMUNITIES

The establishment of pure-seed communities or districts, restricted to the planting of one variety, is necessary to a full utilization of superior varieties of cotton. No other way has been found for keeping the seed pure and for producing sufficient quantities of pure seed so that all the farmers of a community can be supplied. The breeding of superior varieties is to little purpose unless the select stocks are preserved and utilized for producing the superior fiber in commercial quantities.

The organization of communities for growing pure seed is as necessary as breeding the varieties or keeping up the selection of the seed stocks. The variety problem is essentially a community problem, since the individual farmer is seldom in position to maintain a stock of pure seed and has no assurance of getting a premium for fiber of better quality (*7*).

The production of better and more uniform fiber should be recognized as a necessary feature in any effort to obtain a large return for the farmer. The cost of marketing cotton can be reduced at the same time that the quality of the fiber is improved by holding to one variety. Cooperative marketing of cotton is being urged upon the farmers, but often without recognizing the market advantage of having a uniform product to sell. The commercial classing of the bales, which is necessary in mixed-variety communities, adds greatly to the cost of cooperative marketing of cotton, but the difficulties and expenses of classing are largely avoidable through standardized community production of one variety.

The full advantages of cooperative marketing of cotton are not obtained unless the community has a high-quality standardized product to sell, and this condition is not reached unless the community restricts itself to one variety and continues to grow that variety through a period of years. A stabilized production is necessary in order to work out the marketing problem of getting a full price for the farmer. The experience of other industries in cooperative marketing needs to be studied in cotton-growing communities (*7, 9, 11, 14*).[2]

Undoubtedly it is easier for the growers of a community to unite on a variety with outstanding characters like the Acala, but those who are interested in the progress of their communities should recognize the value of the one-variety plan apart from the merits of any particular variety. Many farmers are anxious to be assured that the Acala or some other cotton is absolutely the best for their conditions but without taking account of the need of changing the system of production in order to maintain the variety. They are open to the suggestion of new varieties and are ready to change frequently from one variety to another, whereas they should be interested in holding to one variety and cooperating with their neighbors who use the same gin, so that supplies of pure seed can be maintained.

Many attempts have been made to improve cotton by making hybrids to combine the desirable qualities of different types, as Egyptian and upland, or upland and sea island, but thus far these efforts have not resulted in any practical success. Such hybrids appear very promising in the first generation, which is uniform and productive, but the later generations break up and degenerate rapidly. The cotton mongrels are very diverse and have many freaky, unproductive plants and some that are completely sterile. The injury to the crop and the loss to the farmers from allowing different varieties of cotton to mix are of the same nature as those that result when different breeds of cattle or poultry are mongrelized.

The restriction to one variety protects the farmers of an organized community against the usual mixing and mongrelizing of the seed stocks so that it is possible to increase the supplies of pure seed to any extent and the way is opened for a substantial improvement of production and marketing conditions for the community as a whole. Greater skill is developed in the handling of the crop where only one variety is grown, so that the yields are larger and the fiber is of better quality. The need of careful ginning is being recognized and enforced in the more advanced communities, in order to obtain high grades. In some of the Acala communities in California, yields of a bale per acre are commonly obtained, 2-bale yields are not infrequent, and yields of almost 3 bales have occurred. When all the farmers plant select seed of the same variety the fiber is of more uniform quality and brings a higher price in the market.

In communities that have had the advantage of the best seed stocks of Acala for a few years, a reputation for producing a better staple is being established, more competent and discriminating buyers are attracted, and premiums of about 5 cents a pound are being paid to the farmers who produce the best Acala fiber. Such values are not obtained unless the seed stocks are preserved unmixed from year to year and commercial quantities of good fiber are produced regularly. Improvement of production is a substantial basis for a gradual improvement of market conditions in one-variety communities, because manufacturers have an assurance that fiber of the same quality will be obtainable from the same districts in the future.

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[2] Motion-picture films on one-variety organization and cooperative marketing are obtainable from the Department of Agriculture. These are entitled: "John Doe's Cotton—and Yours," "Cooperative Marketing—Cotton," and "Cooperative Marketing in the United States."

Regularly organized one-variety communities have been limited thus far to the new cotton-growing districts in the southwestern irrigated valleys, although the need of adopting this improvement is being recognized in the eastern Cotton Belt. Unquestionably, the Acala variety is being utilized to much greater advantage in the one-variety communities that have adequate supplies of pure seed and produce commercial quantities of uniform fiber. The same advantages of community production were demonstrated with Pima cotton, a variety of the Egyptian type that was grown exclusively for several years in the Salt River Valley of Arizona, with good returns to the farmers. But in the war period special difficulties in the marketing of Egyptian cotton were encountered that led many farmers to plant upland varieties, with a resulting mixture of seed and deterioration of the crop on many farms.

Acala is the first variety of upland cotton to be produced regularly in communities that are definitely restricted to one variety. The advantages of community production are being recognized with other varieties in the eastern Cotton Belt, and separate one-variety gins are being established in Texas and other States. In many communities the bulk of the crop is of one variety, or of varieties that produce fiber of nearly the same character, as Lone Star, Rowden, Mebane, or Kasch in Texas, but it is not known that any eastern communities are definitely restricted to one variety so that there is no crossing of different varieties in the fields and no mixing of seed at gins or in other accidental ways.

The western Acala communities may serve as examples of progressive methods and also as sources of seed supplies, since the variety is adapted also to the eastern Cotton Belt. Western supplies of Acala seed may be drawn upon for establishing new communities, or after unfavorable seasons when local seed stocks are lost. Keeping up local stocks of good seed is more difficult in districts that have a wide range of seasonal conditions, as in parts of Texas. In recent years there have been many cases where local supplies of good seed were greatly reduced or even entirely destroyed by boll weevils or by periods of unfavorable weather. Wet weather in the fall may rot the seed in the bolls, or the seed may be lost in the spring by conditions that prevent germination or destroy the seedlings. To meet such emergencies good seed must be obtainable in other regions, if a serious deterioration of the crop is to be avoided.

SEARCHING FOR WEEVIL-RESISTANT VARIETIES

Growers of the Acala variety may be interested to know that the discovery of this new type of cotton resulted from a search that was made in tropical America for varieties resistant to the boll weevil. There are many indigenous species and varieties of cotton in Mexico and Central America. The Texas big-boll type is one of the Mexican cottons and is supposed to have been introduced about the time of the war with Mexico.

The first indication of weevil resistance was found in 1902, in the Department of Alta Vera Paz in eastern Guatemala, where cotton culture is regularly maintained in the presence of the boll weevil by the Kekchi Indians, one of the tribes related to the ancient Mayas. A small early type of upland cotton is used for field planting among the Kekchis. A search for boll weevils was made in a field of the small native cotton, but no weevils or infested buds were found, although weevils were present in large numbers on another kind of cotton only a few rods away from the field of small cotton.

The Kekchi country was visited again in 1904 to determine the causes of immunity of the native cotton. A remarkable antlike insect that caught boll weevils and other insects and protected the crop to a considerable extent was found on the cotton plants (*3*).

Some of these insects were brought to Texas to see whether they could be established in the cotton fields, and plantings of the Kekchi cotton were made in Texas in 1905 to compare the behavior of the insects on the different kinds of cotton.

The Kekchi cotton attracted attention in Texas because of its remarkable behavior under the new conditions. The plants grew 8 to 10 feet high, and in many cases were completely sterile, though becoming acclimatized and fruitful a few years later. As a result of these investigations it was found that several characters of the Kekchi variety afforded partial protection against the boll weevil (*4*, *5*).

DISCOVERY OF A SUPERIOR TYPE

The cotton explorations were extended in 1906 to several other districts of Guatemala and southern Mexico. The northern departments of Guatemala were crossed from Livingston on the east coast. The State of Chiapas, in southern Mexico, was traversed and the Gulf coast was reached at Frontera. The routes that were followed in this expedition are indicated in the accompanying sketch map. (Fig. 1.)

Many native cottons had been observed during the expedition, but a single plant of upland cotton seen at Ocosingo, in the eastern part of Chiapas, on June 17, 1906, attracted special attention and was recognized at once as a new and interesting type. The important features were the upright habit of growth and the large, well-formed bolls. The normal bolls were still green, but a few seeds were found in a defective early boll which showed that the fiber was longer and more abundant than in any large-bolled variety of upland cotton known at that time in the United States.

On questioning the people of the neighborhood it was learned that this was the only plant of the kind and that its existence was entirely accidental, since nobody planted cotton at Ocosingo. They explained that a little cotton was brought every year from San Cristobal for spinning and weaving by hand, and that a few seeds of the cotton from San Cristobal had been swept into the roadway. Several seedlings had come up, but only the one plant had survived. This information was verified from different sources; that no cotton was grown around Ocosingo and that all of the cotton used for spinning was bought in San Cristobal.

Several characters of the plant at Ocosingo were noted in comparison with the Kekchi and other native cottons which had been studied in Guatemala. The habit of growth was more upright than the Kekchi, though the plant was low and fruitful. The bolls were larger than in Kekchi, showing some resistance to weevil punctures, and with the tips of the divisions rather thick and fleshy. The oil glands of the bolls were not numerous or conspicuous, but were generally distributed, and there was no indication of a naked band along the middle of the carpel. The involucral bracts were not so large and the margins not so fitted together as in the Kekchi cotton. The outer and inner nectaries were rather small and deep-set, the receptacle around the outer nectaries being somewhat prominent and swollen. The leaves were mostly three-lobed, with rather small leaf-nectaries, usually confined to the midvein. The seeds were densely fuzzy and the fiber very long for a cotton with large bolls.

The characters noted at Ocosingo are recognized in the present Acala variety. The examination of the one plant by the roadside had shown that a superior type of upland cotton existed in southern Mexico, which might be a valuable addition to our series of varieties if it could be acclimatized and adapted to the conditions of cotton-growing regions in the United States.

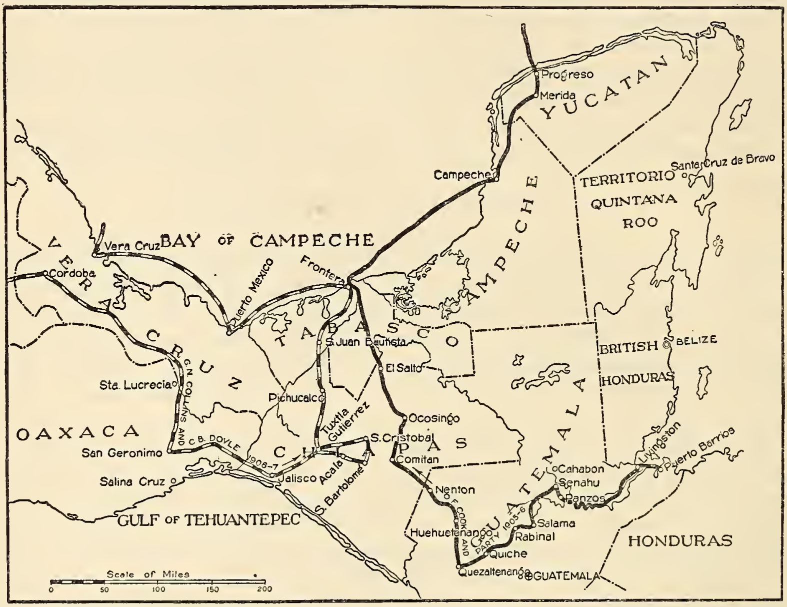

FIG. 1.—Sketch map of parts of Guatemala and southern Mexico, showing the routes followed by O. F. Cook and B. T. Jordan in 1905–6 and by G. N. Collins and C. B. Doyle in 1906–7

SEED OBTAINED AT ACALA, MEXICO

The exploration of southern Mexico was continued in December, 1906, to locate the superior type of cotton that had been recognized at Ocosingo in June. G. N. Collins and C. B. Doyle left Washington November 25 and reached Tuxtla Gutierrez, the capital of Chiapas, December 18 through Rosario. (Fig. 1.)

At Rosario cotton was being grown, and it was learned that a method of avoiding the boll weevil was being used, although the reasons had not been clearly understood. Several years before, cotton growing had been undertaken by a group of the local plantation owners, and all had good crops the first season. One of the finqueros had learned that it was not safe to raise cotton every year, but the others refused to take his advice and planted cotton again in the following season, but no crop was obtained. Also they persisted in planting for three more seasons. Each year the crop was a total failure, and they then abandoned the idea of growing cotton at Rosario. After waiting over a year, when no cotton was planted, one of the finqueros put in considerable acreage of cotton and obtained a good yield. Since that time he had continued to get good crops of cotton by planting every other year, relying on corn, beans, and tobacco in the alternate seasons.

Open bolls of cotton of strikingly large size were found in the native market at Tuxtla Gutierrez. A basket of cotton was purchased, and the large size of the bolls was verified, 38 bolls producing a pound of seed cotton. The fiber was abundant, $1\frac{3}{16}$ inches in length, and apparently of high quality. The cotton was said to have come from the village of Acala, about 25 miles southeast of Tuxtla Gutierrez; therefore a visit to that district was next undertaken.

The journey to Acala from Tuxtla Gutierrez required several hours on horseback through an arid country. The interior of Chiapas is an elevated plateau region, having in some parts open forests of pine and oak, like those in northern and eastern Texas, but in other districts native vegetation not unlike that found in parts of southern and western Texas. Hence, the adaptation of a variety from this district to the drier sections of Texas and Oklahoma seemed likely to succeed. (Pl. 1.)

In the outskirts of the town of Acala, which is at an elevation of about 3,000 feet, a small patch of cotton was soon located (pl. 2), with plants of a desirable, large-bolled type, and a sample of the local seed was obtained from the owner of a primitive cotton gin. This lot of seed was labeled Acala in the subsequent experiments in Texas, and it was from this stock that the Acala variety was derived.[3]

Other points visited in the search for native cottons were San Bartolome, San Sebastian, Teopisco, and San Cristobal, through dry elevated regions with stretches of pine and oak forests. After returning to Tuxtla Gutierrez the northern route to Frontera was followed through Pantepec and Pichucalco, but without finding other superior types of cotton.

Around San Bartolome the same idea of cotton growing was current as at Rosario, that cotton would not do well if planted every year, although nobody could be found who had any idea of why the crop would fail. Cotton is grown at San Sebastian in the same fields as corn and beans, but the crops are planted at different dates in order to interfere with one another as little as possible. (Pl. 3.) The cotton was planted in August, and the bolls were beginning to open at the end of December. A good crop, estimated at more than a bale per acre, was in sight. A large proportion of the bolls were on long basal branches near the ground. The bolls on such branches did not show weevil injury, although the insects were present in great abundance on the plants. The Acala cotton in the United States often shows the same tendency to continue the production of bolls on the lower fruiting branches where there is less danger of weevil injury.

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[3] The cotton found at Acala did not prove to be the same as the variety having the extremely large bolls purchased in the market at Tuxtla Gutierrez. Although good results were obtained from experimental plantings in the United States of the latter variety, which was given the name Tuxtla Big-Boll, the behavior of the Acala cotton appeared more promising. On this account the subsequent acclimatization and breeding work was devoted largely to the Acala cotton, although small seed stocks of the Tuxtla variety have been maintained.

ACCLIMATIZATION OF ACALA COTTON

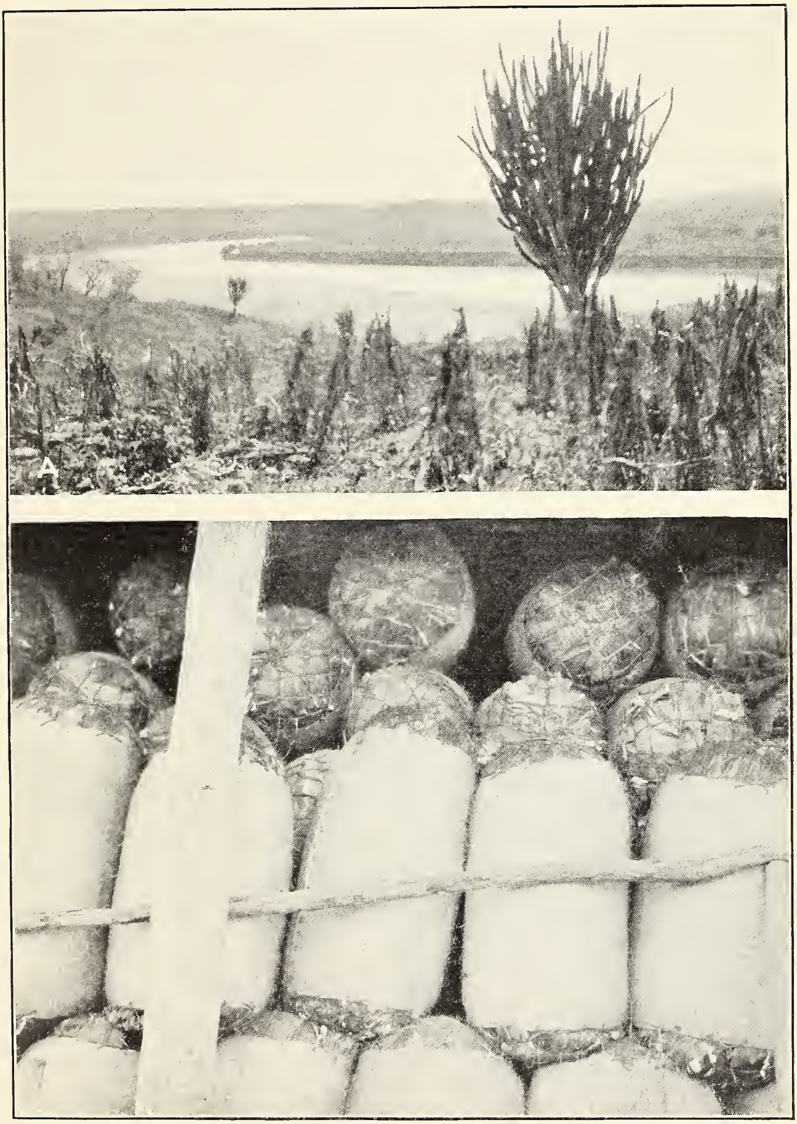
Little difficulty was encountered in the acclimatization of the Acala cotton in the United States. Plantings of the imported seed in several localities in Texas showed only a slight tendency to the rank growth and sterility that had characterized the early generations of the Kekchi cotton and other types from tropical America. The similarity of conditions in the Acala districts in Mexico to those of Texas may afford an explanation of the contrasting behavior of the Kekchi and Acala stocks when grown for the first time in Texas. The climate of the Kekchi country in eastern Guatemala is much more humid than that of the table-land district in the western part of Chiapas, where the Acala type was found. In the Kekchi country only the spring months are dry enough for the bolls to open and the cotton to be picked. For this reason the cotton is planted in October or November, makes its growth during the cool winter weather, and is harvested in April or May. Thus the change encountered by the Kekchi cotton in being transferred from winter conditions in Guatemala to summer conditions in Texas was much greater than that encountered by Acala cotton.

The Acala stock showed a wide range of diversity, but most of the plants were fertile and productive, even in the first plantings that were made in Texas in 1907, at Victoria, Kerrville, and Del Rio. Some of the plants showed the characters of the superior type that had been recognized at Ocosingo, with an upright habit, large bolls, and abundant fiber, and were early and productive as well. Hence, it was possible with the Acala stock to proceed at once to the selection of good plants, whose progenies were raised and compared in order to establish superior well-adapted strains.

Breeding experiments were conducted for several seasons in a small isolated field at the south end of the United States experiment station about 6 miles south of San Antonio, under conditions that demonstrated the resistance of the variety to drought, as well as its ability to produce good crops in short periods, even in the presence of the boll weevil.

In 1911 the first field planting of Acala was made at Waco, Tex. This field and many later plantings in northeastern Texas, especially around Greenville and Clarksville, gave very favorable results. In the spring of 1914 a bushel of Acala cottonseed was sent to C. N. Nunn, at that time agent in farmers' cooperative demonstration work in the United States Department of Agriculture, at Okemah, Okla. An isolated planting of about an acre was made on the farm of L. A. Niells.

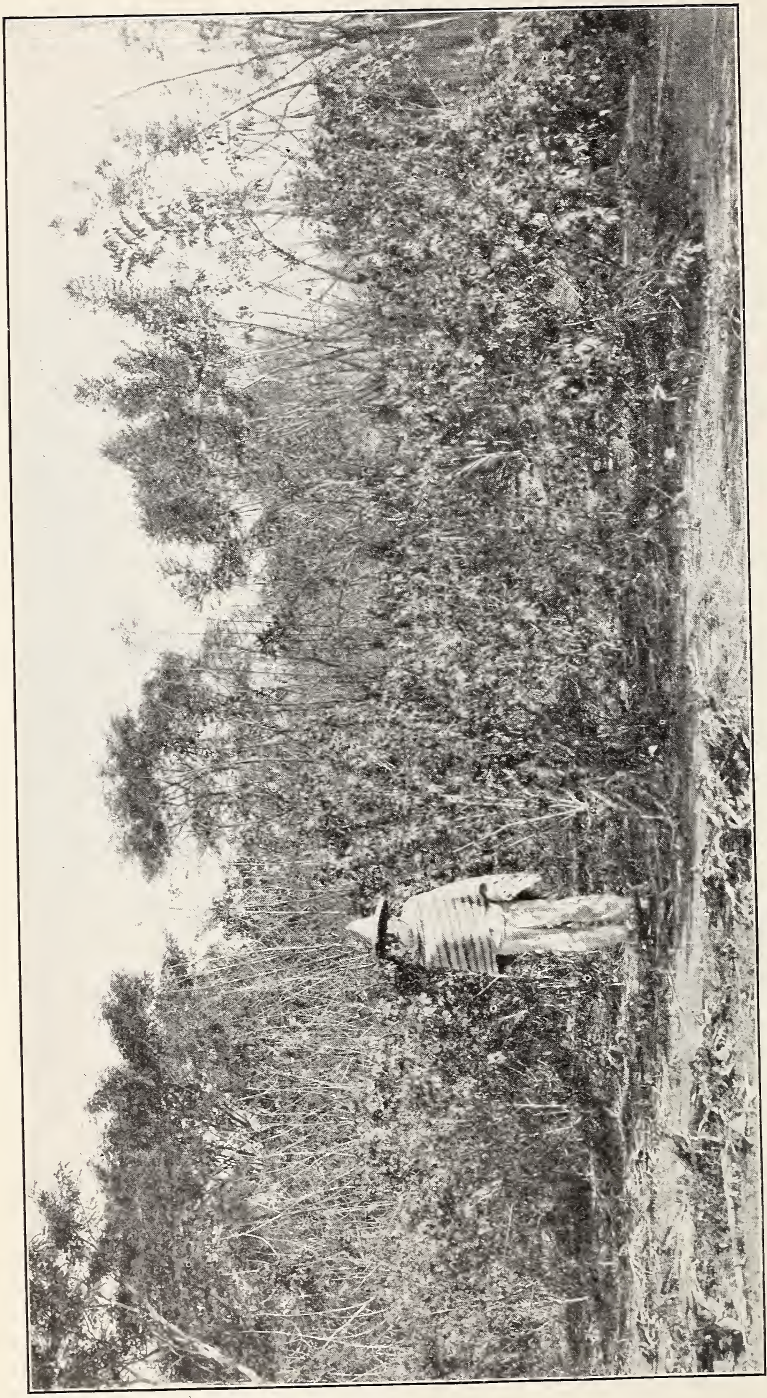
The soil conditions were irregular, but the stock appeared so promising that Mr. Nunn took a special interest in having the field inspected and in saving the seed of the best individuals. The plant-



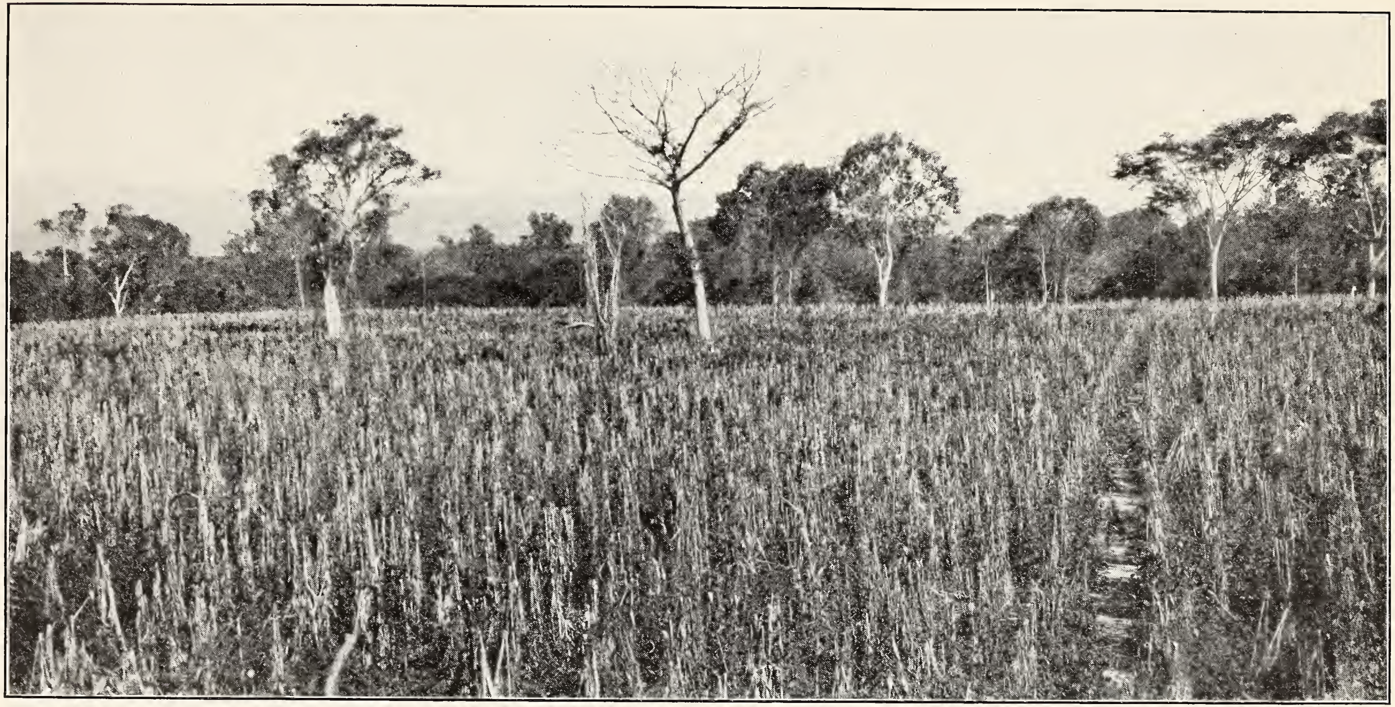
TYPICAL SCENE AND PRODUCTS OF COUNTRY NEAR ACALA, MEXICO

A.—General view, showing dry-land vegetation
B.—Bales of cotton lint ready for mule-back shipment to mills at Providencia

PLATE 2

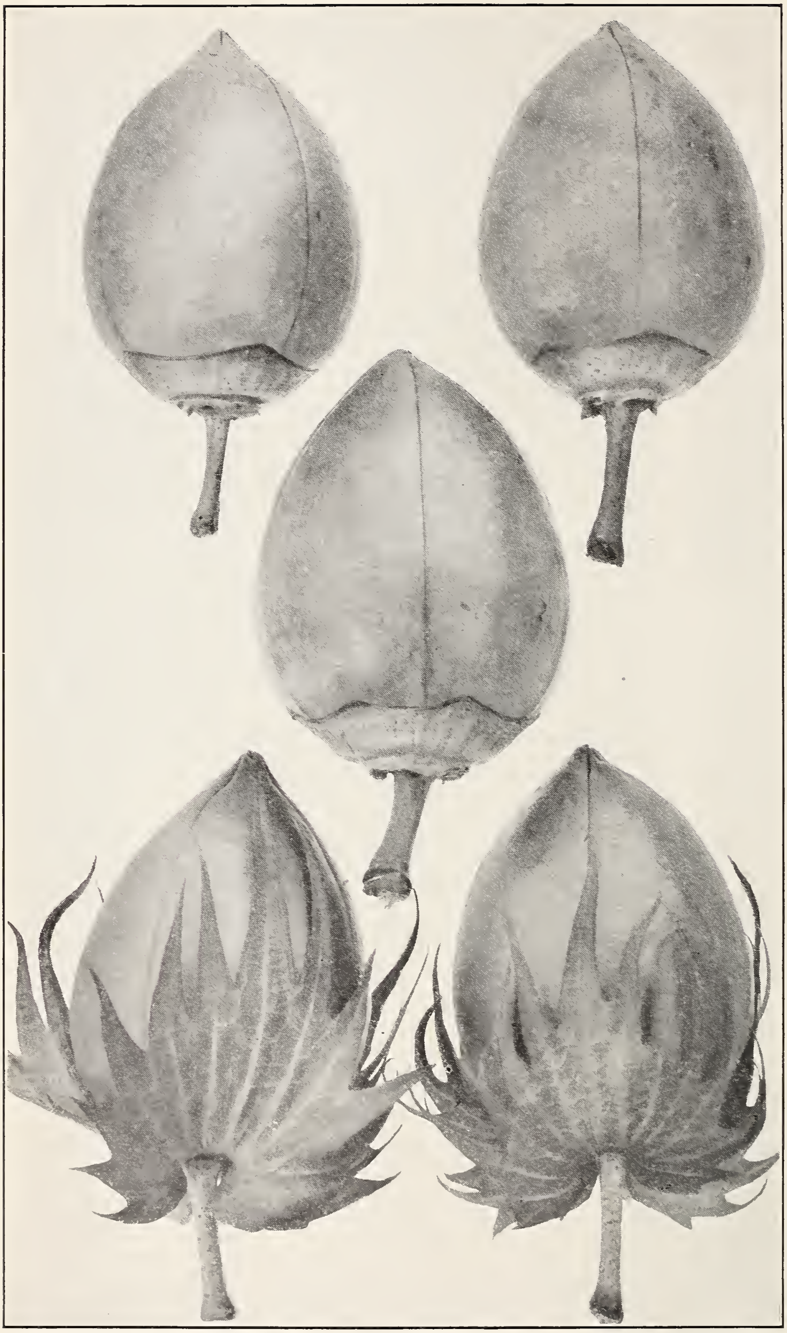


SMALL FIELD OF COTTON AT ACALA, MEXICO, WHERE THE ORIGINAL SEED STOCK OF THE ACALA COTTON WAS OBTAINED



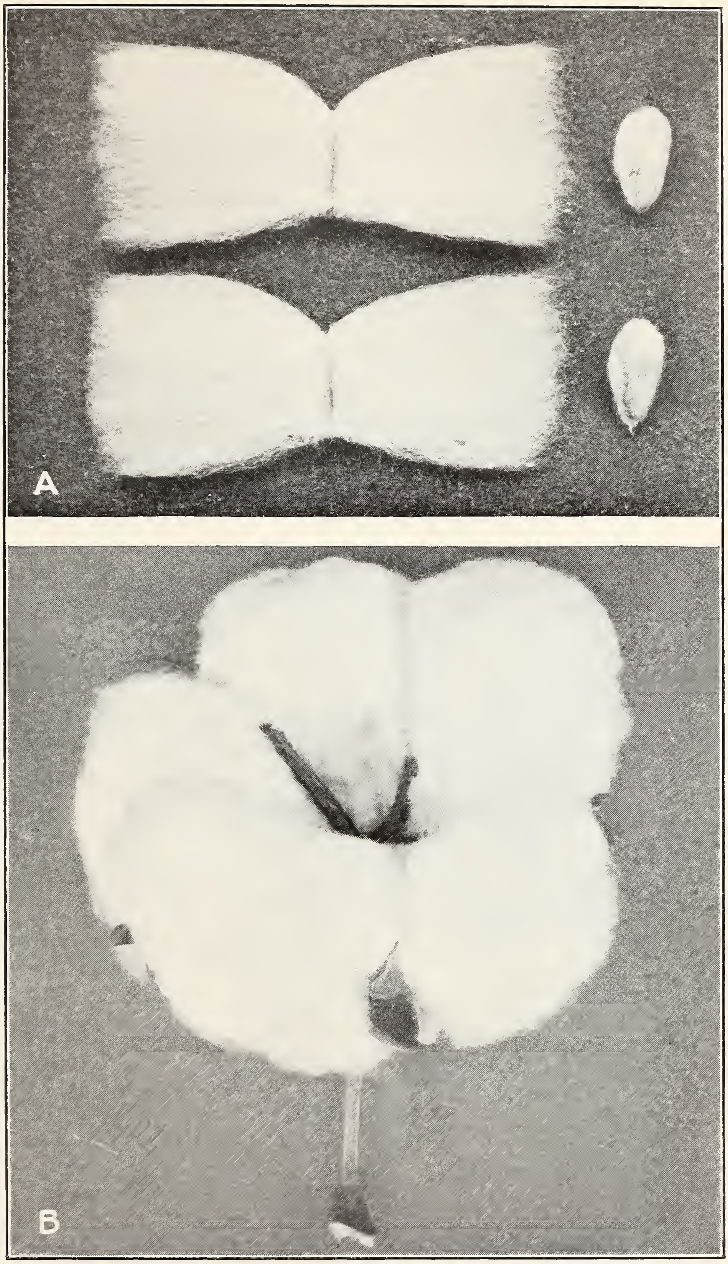
Large Mixed Planting of Cotton, Corn, and Beans at San Sebastian, near Acala, Mexico

The mature corn plants have been "doubled" or broken, after the general custom in southern Mexico, for protection against rain and birds



MATURE BOLLS OF ACALA COTTON GROWN AT INDIO, IN THE COACHELLA VALLEY, CALIFORNIA

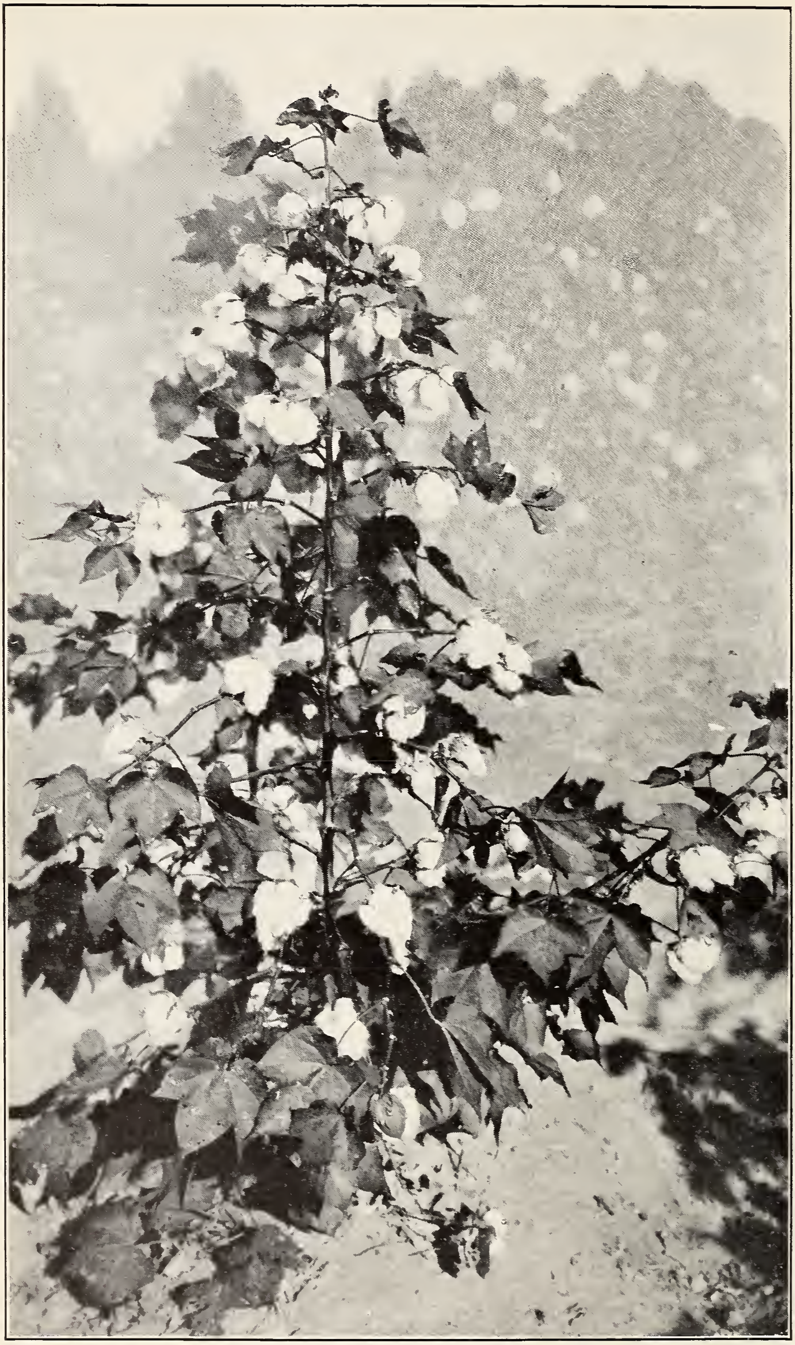
(Natural size)



ACALA COTTON

A.—Lint and seeds
B.—Open boll, showing the compact, storm-proof locks

(Natural size)



A WELL-FRUITED PLANT OF ACALA COTTON, SHOWING UPRIGHT HABIT OF GROWTH ing was visited in the fall by O. F. Cook, D. A. Saunders, and Rowland M. Meade, of the United States Department of Agriculture. After studying the behavior of the Acala stock under the Oklahoma conditions, individual plant selections were made for Mr. Nunn to plant in progeny rows the next season. It was from selection No. 5 of this series that the seed stock later known as " Acala No. 5 " or " Nunn's Acala " was produced.

The No. 5 strain appeared to be specially adapted to Oklahoma conditions, as the plants were somewhat smaller and more compact and the bolls opened a few days earlier. Another selection, Oklahoma No. 8, was carried for several years with other breeding stocks of Acala cotton at Clarksville, Tex., by D. A. Saunders. In this selection the joints of the fruiting branches were not so short, the bolls were somewhat larger, and the fiber was somewhat longer than in No. 5. Two progenies from the No. 8 series and three other progenies from Clarksville were transferred to California in 1921. Breeding work has been continued in California under conditions of better isolation than those in Oklahoma.

CHARACTERS OF ACALA COTTON

In connection with a distribution of Acala seed in 1920, the following account of the variety was furnished (*18*):

> Plant of medium height, with strong, erect main stem. Wood limbs or primary branches few, erect or ascending. Fruiting branches short jointed, zigzag; the lower branches long, becoming very short above, giving the plant a semiclustered appearance. Leaves of medium size, dark green, those of the main stalk usually with five lobes, on the fruiting branches three lobes; the lobes long and very sharp pointed, resembling those of the Durango. Bolls medium size—1½ inches or longer—ovate or ovate-oblong with a rather short blunt point, 50 to 60 to the pound. Involucral bracts rather small for an American variety, rarely reaching more than half the length of the mature bolls; teeth long and narrow and somewhat scythe shaped, often interlacing over the buds. Pedicels of medium length—1½ inches—burs often pendent, of medium thickness, storm-proof, opening wide. Lint $1\frac{1}{16}$ to $1\frac{3}{16}$ inches, usually 1⅛ full, with good drag and extra strong; clear white without creamy tint. Percentage of lint, 32 to 35.
>
> In the shape of the plant, the type of boll, and especially in the quality of the lint, Acala is distinct from all other varieties and is one of the most striking sorts thus far introduced. It meets a distinct agricultural need in maturing somewhat earlier than Lone Star or other big-boll cottons. On this account it promises to be rapidly extended in cultivation in parts of northern Texas and Oklahoma. It is already well known in some communities, and local cooperators and breeders are finding a ready sale for the seed, sometimes calling it " Kelly." Its earliness in these sections makes it especially adapted to the bottom lands, where cotton tends to grow rank and be late in maturing, and on the more northern highlands, where frost shortens the growing season. It is particularly noted also for the good drag and the extra strength of its fiber. In the long-staple market Acala brings a premium of $7.50 to $12 a bale.

In the tests and comparisons of Acala with cottons already known in the United States, special attention has been given to the Texas big-boll varieties, which formed most of the crop in the Southwestern States and were recognized as more resistant to unfavorable conditions than varieties brought from the older sections of the Cotton Belt. The Texas big-boll type was not derived from varieties grown in the Eastern States, but is supposed to have come from Mexico. Possibly it was brought to Texas by soldiers returning from the war with Mexico, in 1848.

Under the same conditions of growth, the Acala plants are more upright, have a stronger main stalk, and usually are a few inches taller than the Texas big-boll type of cotton. The foliage is more open, the leaves are somewhat smaller, and the lobes or angles of the leaves are drawn out to narrower points. In these and other respects the Acala cotton appears to be somewhat intermediate between the Texas big-boll varieties and the Durango cotton from another part of Mexico.

The bracts that inclose the flower buds of Acala are smaller and more deeply cut than those in Lone Star or other big-boll cottons. The teeth of the bracts of Acala extend along the sides and even to the basal auricles, where the bracts of the big-boll varieties have entire margins. The involucre of Acala cotton is less accrescent than that in the Texas big-boll types; that is, the bracts do not continue to grow as the boll develops, nor are they so large at maturity. (Pl. 4.)

The Acala bracts are similar to those of Durango in their small size and long teeth, and these two varieties afford a notable contrast with the Kekchi cotton, which has much larger bracts with broader auricles.

Two advantages may be claimed for the smaller bracts of Acala. In the early stages the smaller bracts afford less protection for weevils which may attack the green bolls, and at maturity less of the "trash" or broken bract material is picked with the cotton, which tends to higher grades.

The form of the Acala boll is distinctive, being longer and more oval than in Lone Star or Mebane and with a more gradual rounding of the base, contrasting with the flat "square" base of the Texas big-boll varieties. (Pl. 4.)

The Acala variety has the "storm-proof" character recognized in the Texas big-boll varieties; that is, the cotton remains in the open bolls for a long time, often for weeks or months, although the bolls open wide and the cotton is easily picked. The reason that Acala is storm-proof and yet is easy to pick is that the cotton of each lock holds well together, on account of the abundance, elasticity, twist, and roughness of the fiber, the same characters that determine the spinning properties. (Pl. 5, B.)

The good spinning character and body of the Acala cotton is indicated also by the long drag and the sharp cry of the fiber, the crackling sound that is made when a lock of the cotton is pulled apart. The staple is 1⅛ full, or $1\frac{3}{16}$ inches when grown under favorable conditions. The seeds of Acala are of medium size and well covered with whitish fuzz. Under some conditions the fuzz may appear grayish or brownish. (Pl. 5, A.)

High percentages of lint, as determined by the turnout at the gin, are reported for the Acala cotton, often above 35 per cent and in some cases 40 per cent of lint, though too much emphasis is often placed on high lint percentages. It has been known for many years that the lint percentage is not a true index or criterion of the value of a variety, or even of good yielding qualities. Varieties with small seeds usually have a higher lint percentage than large-seeded varieties, but they may produce less cotton per acre. Many farmers have confused ideas of these relations (*6*, *16*). Very high lint percentages may be obtained with cotton of low quality, in which the seeds are poorly developed or the ginning is badly done. Dirt and trash that should be taken out may be run into the bales if farmers insist on a high turnout. In the communities that are selling their Acala cotton to the best advantage, good grades are being recognized as much more important than high turnout at the gin, as is explained farther on in this circular, under "Ginning precautions with Acala cotton."

CULTURAL ADVANTAGES OF ACALA COTTON

Several cultural advantages of Acala, as compared with other upland varieties, have been recognized, including earliness, productiveness, ability to make more growth in cool weather, less tendency of the stalks to fall over or lodge on the ground, better ripening of late bolls, and greater resistance to unfavorable conditions. (See pls. 6 and 7.) The differences have been observed in adjoining rows in many experimental plantings, representing a wide range of soil and climatic conditions in Texas, Arizona, and California, as well as in the eastern Cotton Belt. Careful and repeated comparisons of the varieties growing side by side under the same conditions are necessary in order to make definite determinations of the cultural characters.

Short-season conditions demand earliness or ability to set bolls promptly and mature a good crop before frost. Acala is earlier than the Texas big-boll varieties; therefore the cultivation of Acala can be extended farther north as well as farther east. Varieties with smaller bolls may begin to open a few days sooner, but Acala often outyields small-boll varieties under short-season conditions, and besides it produces a superior quality of fiber.

The greater ability to grow in cool weather becomes apparent in seasons of low temperatures in the spring months. The weather sometimes remains so cold for several weeks that the young cotton plants do not grow. The ability to make even a slight growth during the cool period may be an important factor in the setting of an early crop and may in some seasons contribute greatly to the earliness and productiveness of Acala.

The more upright habit and stronger main stalks of Acala are well adapted for close spacing, and they have several other advantages in comparison with the lower and more spreading forms of the plants of Lone Star, Mebane, or other Texas big-boll varieties. Under weevil conditions it is especially desirable to have upright plants and open lanes between the rows, which permit the ground surface to become hot and dry, so that weevil larvae in the fallen squares are killed. Open conditions in the fields are also necessary under the more humid climate of the Atlantic Coast States to avoid rotting of the bolls. Many attempts have been made to establish the cultivation of the Texas big-boll varieties in eastern districts of the Cotton Belt, and good results are often obtained, but growers are discouraged by the rotting of many of the large bolls under the heavy foliage.

The taller stalks of Acala carry the bolls a few inches higher from the ground, which is a convenience in picking and is also a protection against the soiling or staining of the cotton of the lower bolls. Many comparisons have shown that the stalks of Acala are distinctly stronger than those of the Texas big-boll cottons. The Acala plants often stand erect and suffer no damage in places where Mebane and Lone Star are badly lodged, and many of the bolls are lost through rot or mildew from lying on the ground. In some of the experiments half of the bolls were lost on plants that became prostrate.

Another difficulty with lodging is the increased labor of picking. With the plants flat on the ground and badly entangled, it is much harder and more disagreeable work to pick out the cotton than it is to gather cotton from plants that remain upright. As lodging usually indicates a heavy crop, farmers seldom complain, but the advantage of more upright plants is appreciated when the differences between the varieties are understood.

Acala plants bearing many bolls may lean over, but they seldom reach the prostrate condition of the other varieties. The growth of the stalks and the setting of bolls at the top of the plants often continue later in Acala than in the big-boll varieties. Thus a late crop of bolls may cause the Acala plants to lean over while another variety with fewer bolls may remain upright. The continued production of bolls may explain some of the larger yields of Acala as compared with the Texas big-boll varieties, which have more determinate habits of growth.

Three of the more specialized weevil-resistant characters are often observed in Acala. Many buds and bolls are saved by proliferation—that is, by a growth of loose watery tissue around the weevil eggs—which often interferes with the development of the larvae. Proliferation was recognized and described as a form of weevil resistance in the Kekchi cotton, but the account of it in connection with Kekchi cotton is equally applicable to Acala (*5*, *pp. 46*, *58*).

Another form of resistance is the fact that frequently buds containing weevil larvae are held and developed into bolls instead of falling off. The injury in such buds is limited to the stamens and leaves the pistil or boll part of the bud uninjured. Although the flowers that develop from the injured buds may be badly deformed, normal bolls may be set and may escape injury by the weevils.

The third factor of weevil resistance often apparent in Acala is a continued growth and production of buds, flowers, and bolls at the ends of the lower fruiting branches, where there is less danger of weevil injury than farther up on the plant. The protection of such bolls is due to the tendency of the weevil to climb upward on the plants, instead of crawling downward on the drooping lower branches.

Better ripening of late bolls on Acala plants than on Lone Star and Mebane has been shown in some of the experiments. A very striking example occurred at Sacaton, Ariz. The Acala plants, as not infrequently happens, were about a foot taller than the Lone Star, and remained upright, while much of the Lone Star was leaning or prostrate. The late-season green bolls were about equally abundant in the varieties, but those of Lone Star were from 1 to 2 feet closer to the ground than the late bolls at the top of the erect Acala plants. Whether on account of these differences of position or because of some difference in susceptibility to injury by a light frost that had occurred, the late bolls of Lone Star failed to open, but the Acala block furnished another good picking.

In another comparison of the same varieties, near Calipatria, Calif., in the Imperial Valley, it was observed by H. G. McKeever that the frost-killed stalks and foliage of Lone Star and Mebane were of a darker color than those of Acala and that more of the frosted leaves of Acala had fallen off. To have more of the dead leaves out of the way in the last picking undoubtedly would tend to improve the grade of the cotton.

No reason has been found for supposing that any upland variety is more resistant than Acala to unfavorable conditions. Comparisons between Acala and Lone Star and Mebane were made in the Imperial Valley in the season of 1925, the varieties being represented by alternating four-row blocks. The conditions proved very severe, as the soils were impervious and there was a shortage of water, so that the crop was practically a failure for all three varieties; but for determining the effects of adverse conditions no better opportunity could be desired. Careful comparisons of the different blocks showed that the Acala rows had not suffered more than the other varieties, even under the extreme conditions. The Acala plants were somewhat taller, the bolls were as well developed, and the fiber was distinctly better.

The yields were determined and reported by H. G. McKeever, who conducted the experiment in cooperation with E. L. Garthwaite, farm adviser of Imperial County. The rows were divided into short sections, and each section was picked separately, thus providing for numerous direct comparisons between adjacent rows and block sections representing the different varieties. In 15 of the 18 comparisons with block sections of Mebane, the Acala sections gave higher yields. Of 21 comparisons with Lone Star all but one were in favor of Acala. The same relations were found when inside rows of adjacent blocks were compared as when all four rows of the block sections were included, thus showing that the differences were not due to outside row effects or to the "robbing" of one variety by another.

Of course it is not to be expected that every planting of Acala cotton will be satisfactory. Some farmers will be disappointed with their crops even when the best seed is planted. On account of the popular belief in "change of seed," farmers who have poor crops are more likely to blame the variety than to recognize that the seasons or the soil conditions were different or that the methods of handling were at fault. Cultural improvements are needed oftener than a change of varieties. When account is taken of the wide variations in growth and productiveness that often result from differences of conditions in parts of the same field of cotton, the futility of judging varieties in separated fields becomes apparent. It is only by careful and repeated side-by-side comparisons that differences of behavior, yields, and qualities of fiber are definitely established.

MARKETING ADVANTAGES OF ACALA COTTON

Acala cotton has found a ready market, and no defects or difficulties in using the fiber have been reported by manufacturers. In some localities considerable premiums have been obtained, in others only the current prices of ordinary short staples. Of course it is not to be expected that premiums will be offered where farmers are willing to sell staples at short-cotton prices or that full premiums will be paid except in rare cases of active competition among buyers.

In the early years of production most of the fiber was marketed with no separate recognition of the variety. Until the exclusive Acala communities were established in California, so that commercial lots of a uniform standardized product could be offered, the problem of selling at full values did not come up in practical form. The individual farmer often finds that he can not get a premium for a few bales of better cotton, but communities are on a different footing.

There is no such danger with Acala, as with the longer staples, of finding no demand for the cotton, but to get the full premiums for Acala is a definite marketing problem that requires community cooperation. Experience with the Pima cotton in Arizona and with the sea-island and Meade cottons in South Carolina and Georgia shows that it is useless to undertake the production of extra-staple cottons except under conditions of definitely established community cooperation.

With cotton, as with other crops, the marketing problems must be worked out gradually by the farmers interested. The first steps toward market improvement are for the communities to standardize their product and to learn its value, so that they may understand what they are now losing but may hope to gain. The problem of marketing is to get the true return for the farming operations. As a basis for necessary loans, a high-quality standardized product affords better security, so that larger advances or lower rates of interest may be obtained.

Of course it is impossible to know the full value of such a product as Acala cotton until the manufacturers have had a regular supply for a period of years and uses for the cotton have been established on a basis of actual experience. Manufacturers are very anxious to obtain uniform lots of cotton that meet their special needs and to connect with regular sources of supply of such cotton, but the particular uses of the cotton must be established and the commercial relations adjusted in order to reach any complete or satisfactory solution of the marketing problems. The demand for uniform fiber of the quality that Acala produces under favorable conditions is greater than ever before, including the special requirements of the automobile industry added to the previous uses of such cotton. The cotton used in automobile tires in 1925 was estimated at 750,000 bales, 600,000 in the United States and 150,000 in Europe.

The advantages that are more immediately and readily in reach of producers of good Acala cotton may be estimated at from 2 to 5 cents a pound above the current quotations for short staples. Such premiums are usually obtainable under present commercial conditions. Even on short cotton from the southwestern valleys premiums of 1 or 2 cents may be paid for cotton that is pure white and has none of the staining or wet-weather damage that is general in the East. The premiums that are paid for staple cottons of $1\frac{1}{8}$ or $1\frac{3}{16}$ inches vary widely under different market conditions, from 2 to 10 cents a pound, but commonly range from 2 to 5 cents. Indeed, such premiums are often paid for cotton that is less uniform in the bales than the product of the good stocks of Acala seed in the southwestern valleys.

Special uses for Acala cotton have been reported recently from England and France that may improve the market outlook still further if a regular production is maintained. In particular, it is claimed that the Acala cotton takes dyes better than most cottons of the same length of staple.

CLASSING SIMPLIFIED BY PRODUCTION FROM PURE SEED

Many of the difficulties and costs of the present commercial system are connected with the classification, or "classing," of the cotton into the even-running lots that the manufacturers require. Under the usual conditions of production, where different varieties and gin mixtures of seed are planted, classing of the individual bales is necessary, but a simpler system of classing may be developed and applied to the uniform cotton of one-variety communities.

In a one-variety community the conditions in the different fields are readily recognized by the behavior of the plants. Where the conditions are uniform the fiber is uniform, and the fact of uniformity can be determined more readily and definitely in the field than after the cotton is in the bales. By observing the conditions and behavior of the plants in the different fields, it is possible to know the quality of the cotton even before picking. In a one-variety community classing could be done easily and effectively by taking account of the origin of the bales from the different fields, farms, or neighborhoods.

The grade depends upon the condition of the cotton, as determined by the weather or by the care used in picking and ginning, whereas classing takes account of the underlying quality and uniformity of the fiber, which go back to the seed stock that is planted and to the normal development of the plants. Where a uniform seed stock is planted the quality of the fiber is affected only by the conditions of production. Different grades of cotton may come from the same field, but not different classes of cotton, unless the conditions are very irregular. Different staple lengths may be reported, even by competent classers, from bales produced on the same uniform field, but this only shows that classing is an art of approximation, not an exact science (*13*).

ACALA COTTON IN CALIFORNIA

Cotton has become one of the principal crops in the warmer irrigated valleys of southern California, and in several districts the Acala variety is grown exclusively. Before any field plantings were made the variety was tested in several localities in comparison with Durango and with a series of Texas and eastern varieties. Many of the experiments were conducted at Bard, Calif., in the Colorado Valley, near Yuma, Ariz., and others at El Centro, Bakersfield, Fresno, and Chico, Calif. The experiments were continued for several years and showed that the Acala variety was well adapted to the conditions.

The most important cotton district is the southern part of the San Joaquin Valley, around Bakersfield. The area is larger, the soil conditions are generally more favorable, and the seasonal conditions are more regular than in some of the more southern valleys. Even in the Sacramento Valley there may be districts where good crops of Acala cotton can be grown, as is shown by experimental plantings that have been conducted for several years at Chico. The danger to be recognized is that the plants may grow well in many places where the seasons are too short for the bolls to open before frost or before the weather becomes too wet for the harvesting of the crop. In favorable seasons the bolls may open and allow the crop to be gathered, but in other years there may be no cotton that can be picked.

Failure of the bolls to open, because the weather is too cool in the autumn months, must be considered as a serious limiting factor in some parts of California, as well as cold spring weather, which may delay the growth of the young plants. Even where the outlook appears promising, with plants heavily loaded, bolls extra large, and fiber of excellent quality, there may still be a complete failure if the crop can not be harvested. The opening of the bolls is an essential feature which must be assured as a basis of any regular or profitable production of cotton. Even in the San Joaquin Valley the cotton possibilities of the more northern and outlying districts are still uncertain. Though good yields may be obtained in some seasons, other seasons may be so short or so cool that the crop is lost. Experience with local seasonal conditions is the only basis of judgment.

The first field planting of Acala cotton in California was in 1919, when 8 acres were grown near Bakersfield from seed brought from Clarksville, Tex., by the United States Department of Agriculture. The crop was profitable to the grower, who sold 8 bales of cotton at 47 cents a pound and about 7,000 pounds of seed at 5 cents a pound. Most of the seed was planted in the neighboring district, to the extent of about 350 acres in 1920. Also in 1920 a small planting of the same seed was made at the United States Experiment Date Garden near Indio, Calif., which yielded at the rate of 2.8 bales per acre. The interest aroused by this planting led to the formation of an association of growers in the fall of 1920 to establish an exclusive production of Acala cotton in the Coachella Valley (*14*). (Pl. 8.)

The public was warned that such exceptional returns were not to be expected under usual conditions of production and marketing of the crop, but many cases of 2-bale yields of Acala have occurred, and a bale per acre is considered as a normal crop in the Coachella and San Joaquin Valleys. Under the special conditions of the Coachella Valley the holding of cotton fields over from one season to another sometimes proves very successful, though generally it is not advisable. One of the "hold-over" fields yielded 56 bales on 17 acres in the second season, following a crop of 34 bales in the first season, although the cotton was planted very late, about the middle of June. Another hold-over field yielded 13 bales on 3½ acres, or nearly 4 bales to the acre.

Since the Coachella Valley is completely isolated from other cotton-growing regions, the problem of isolating the stocks of pure seed was greatly simplified. But in this valley only a few thousand acres are available for cotton, on account of dates and other valuable fruit and truck crops that use most of the land. As in several other valleys, the volume of production of cotton is not large enough for a proper solution of the marketing problems. The best results are not to be expected unless all of the valleys can cooperate in production and market improvements.

A well-established and successful production of Acala cotton in the San Joaquin Valley is to the advantage of all of the other districts, as it tends to assure a better market outlook for all the good Acala that the other communities may grow. The idea of competition between the various cotton-growing districts is entirely out of place. In this respect the cotton industry is different from other lines of production, which the communities would enter as competitors in a limited market, as a good cotton becomes more valuable as production increases and regular supplies are assured. Hence, the efforts that are being made in the San Joaquin Valley to develop a better system of marketing the cotton should be appreciated and seconded in the other valleys. The more profitable cotton is to the farmers, the better the prospect of maintaining a practical volume of production. It will require the joint production and cooperation in marketing the crop of all the irrigated valleys to give the southwestern cotton a regular industrial and commercial status.

ACALA COTTON IN ARIZONA

The chief cotton-growing district in Arizona is the Salt River Valley; the other districts are the lower Colorado Valley below Yuma and the upper Gila Valley in Graham County. Conditions in the Salt River Valley are favorable for the Egyptian type of cotton, an exclusive production of the Pima variety having been maintained for several years, but on account of the very low prices of Egyptian cotton in the period of post-war depression, many farmers changed to upland varieties.

Several upland varieties were planted at first, including Lone Star, Mebane, Hartsville, and Durango, but they were gradually replaced by Acala. Comparisons of Acala with the other varieties were made in several districts, including a series of test plantings at the cooperative testing station at Sacaton. The results of these experiments, conducted for several years, showed that the Acala cotton was better adapted to the local conditions than the other upland varieties. Seed of Acala was obtained in large quantities from California and in recent seasons has furnished the bulk of the crop, though Pima cotton is still planted and might regain its former popularity if satisfactory price relations could be established.

A curious disorder known as crazy top, which causes sterility and results in many abnormalities of the late-season growth of the affected plants, appears in many fields in the Salt River Valley. Crazy top was first recognized in the Pima variety of Egyptian cotton, but more striking abnormalities are shown by Acala and other upland varieties, including Mebane and Hartsville. The affected plants show abnormal habits of branching, often with vegetative limbs produced near the top of the plant instead of near the base, which suggested the name "crazy top." In severe cases all of the plants may become definitely abnormal and deformed, though with striking differences among the individual plants. Analogies between crazy top and some of the so-called mosaic diseases of cotton and other plants have been pointed out, including the fact that the disorder is not carried over in the seed (*10*).

No differences in susceptibility to crazy top have been recognized among the upland varieties. A relation to soil conditions is indicated also by a marked reduction or disappearance of the crazy top symptoms after crops of alfalfa have been grown, while on adjacent land that has grown cotton continuously the plants may show striking crazy top symptoms. Whether the crazy top injury is an effect of stress or is due to some other cause remains to be determined, but the relation to the soil conditions shows a practical remedy. There is nothing to indicate that other upland varieties would suffer less than Acala from crazy top or from other prevalent diseases, as root rot, anthracnose, and black arm. These diseases attack all of the varieties, but the injuries depend upon the conditions rather than upon the variety that is planted. The Egyptian cotton appears to be more susceptible to attacks of black arm, but only in places where the plants are checked by unfavorable conditions.

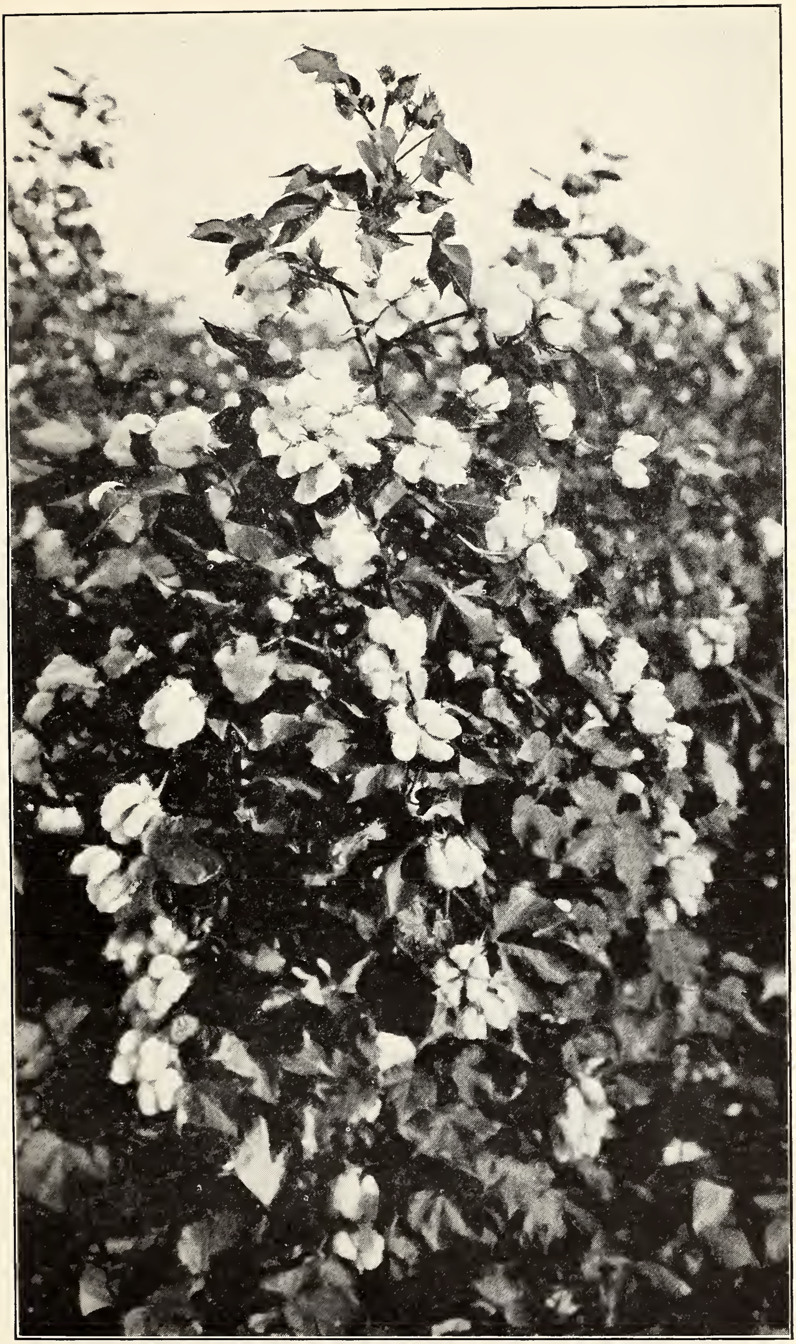
ACALA COTTON IN TEXAS AND NEW MEXICO

A new agricultural region with a rapidly increasing production of cotton is being developed in the elevated districts of western Texas and New Mexico. The Durango and Acala varieties, which came from the table-land regions in Mexico, seem to be especially adapted to the high-altitude districts. The plants are not so large as in the valleys farther west, but they are very vigorous and productive, so that large yields are often obtained in spite of the rather short seasons. In the Mesilla Valley of New Mexico a yield of 53 bales from 22 acres is reliably reported.

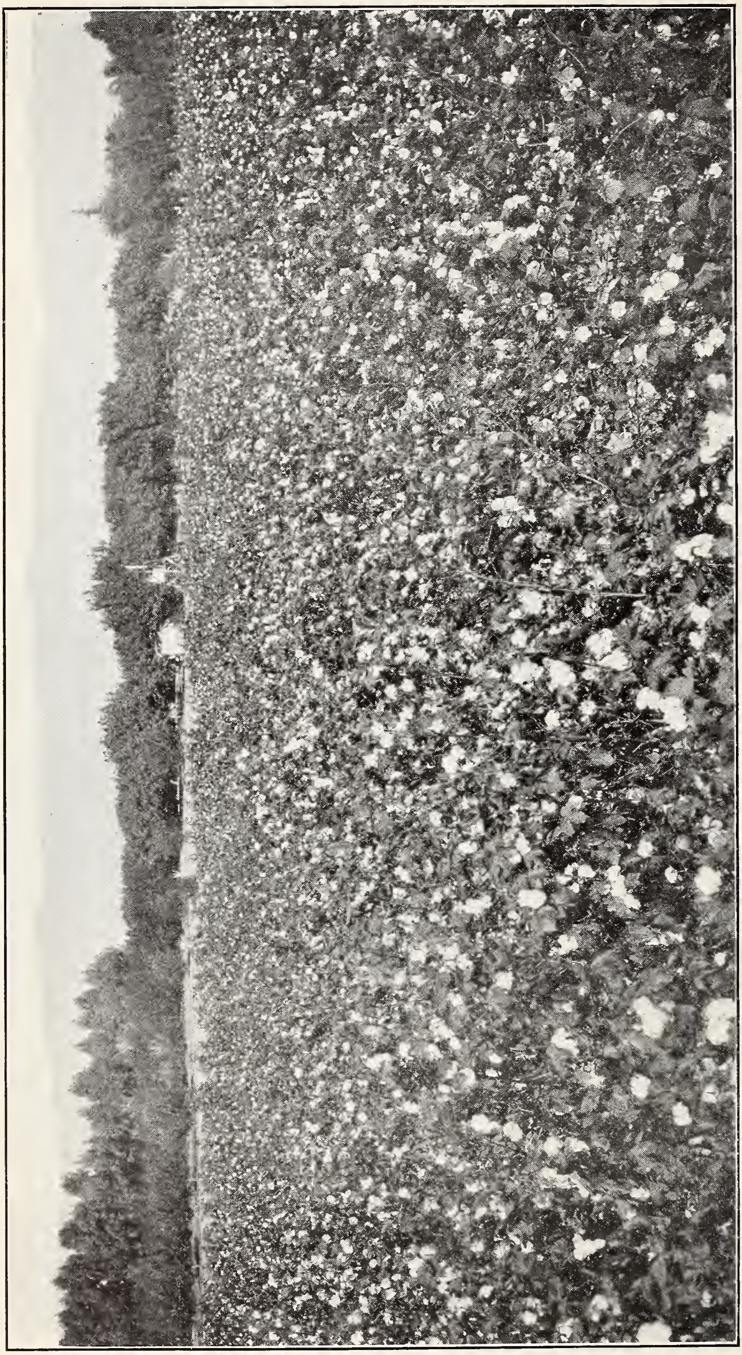
A former production of Durango cotton in the Pecos Valley of New Mexico has largely given place to Acala. Also in the Rio Grande Valley below El Paso most of the cotton is Acala, though stocks of pure seed have not been maintained.

Efforts are being made to establish one-variety communities in the Mesilla Valley, around Las Cruces, and in other districts, and experiments are being conducted in cooperation with the State College of Agriculture at Mesilla Park to develop a uniform seed stock adapted to the local conditions. The Texas and Oklahoma seed stocks show many inferior, short-linted plants, and even California seed stocks appear to be less uniform than in some of the valleys at lower altitudes farther west. The bolls generally are larger and broader under the high-altitude conditions than in the warmer valleys. (Compare pls. 4 and 9.)

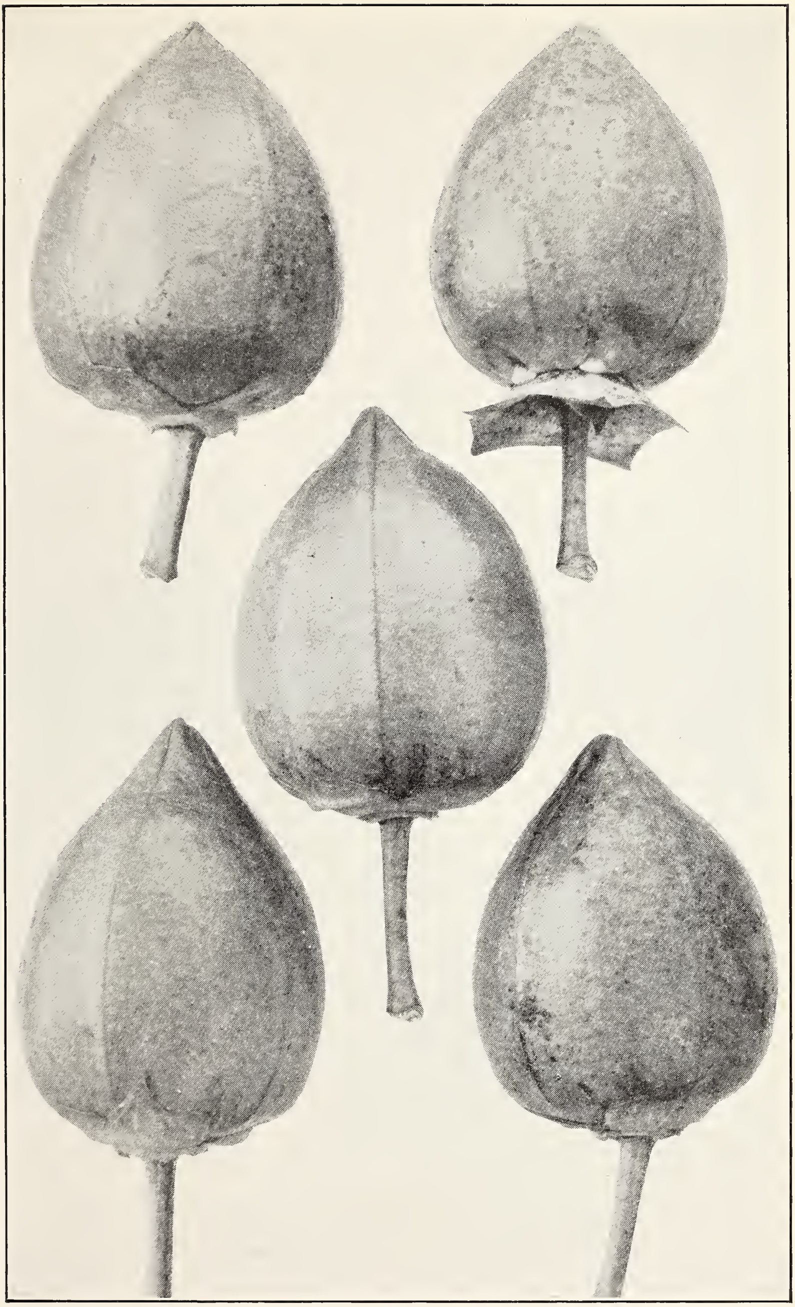
There is no question that the variety is well adapted to conditions in the principal regions of production in Texas and Oklahoma or in States farther east, if the requirement of good seed is not neglected. Careful and repeated tests have been made, especially at San Antonio, Greenville, and Clarksville. In these tests Acala proved most productive or stood close to the top, in second or third place. In 1925 a California seed stock of Acala was compared at Clarksville with Lone Star, Mebane, and Kekchi, and it outyielded the other varieties. But the yield differences between the Acala and the more



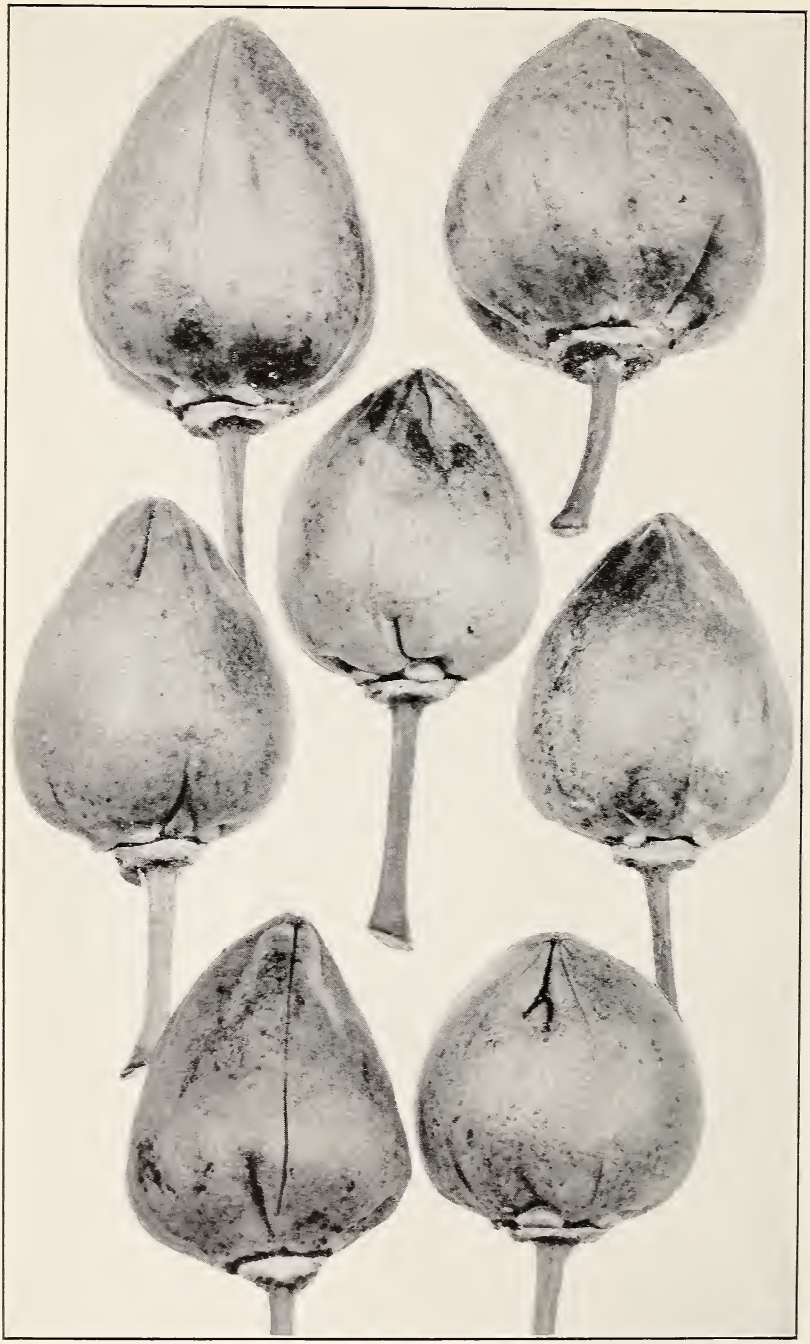
CLOSE-UP VIEW OF TOP OF MATURE PLANT OF ACALA COTTON, SHOWING ABUNDANT FRUITING HABIT



FIELD OF SELECT ACALA COTTON IN THE COACHELLA VALLEY, CALIFORNIA, BEING GROWN TO INCREASE SEED STOCKS



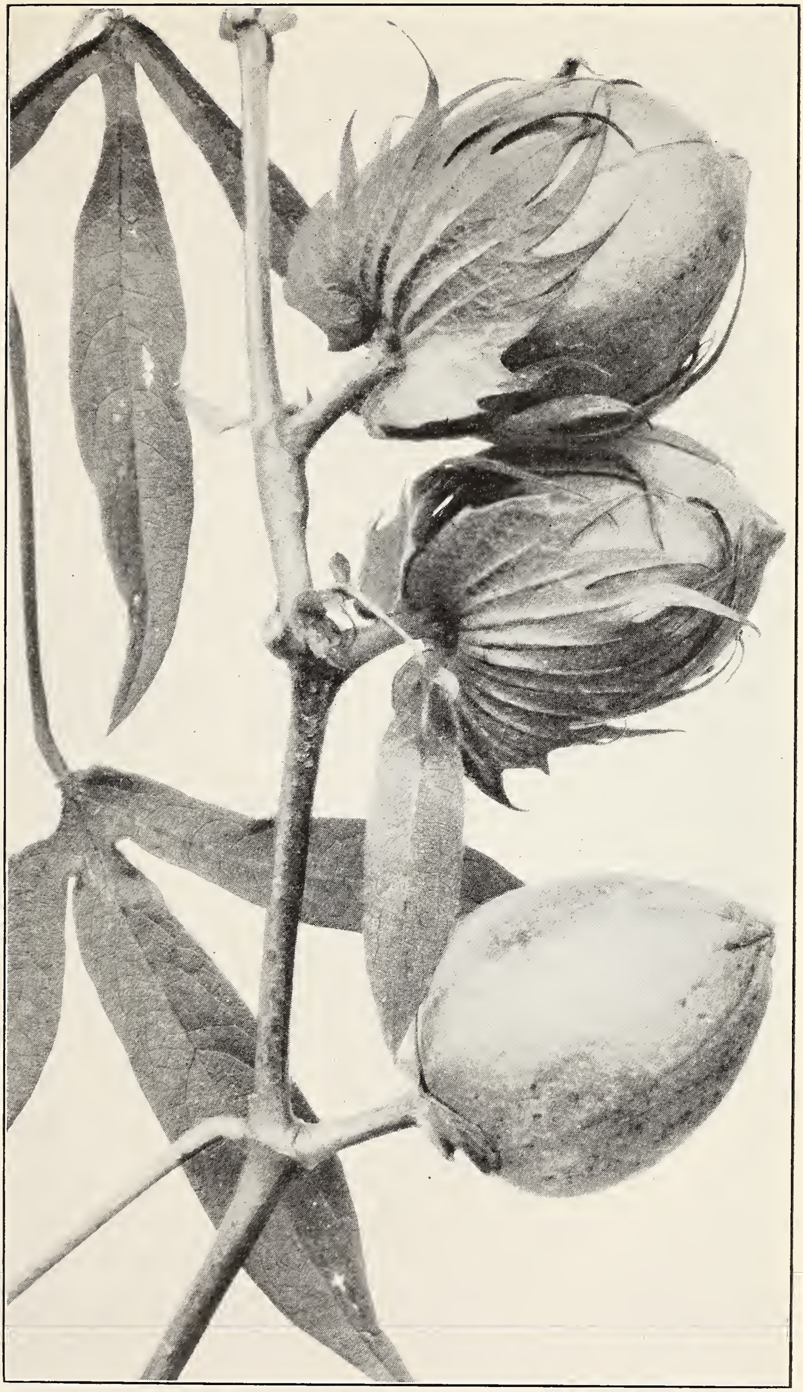
LARGE BOLLS OF ACALA COTTON, PRODUCED UNDER HIGH-ALTITUDE CONDITIONS AT STATE COLLEGE, N. MEX., SHOWING MODIFIED FORM AND BASAL GROOVES



BOLLS OF ACALA COTTON FROM MANCHESTER, N. C.

Grooves or folds are shown along the sutures between the locks. Such "split-nose" bolls are recognized as a heritable deformity, comparable to the harelip defect in animals

(Natural size)



NARROW-LEAF SELECTION OF ACALA COTTON, SHOWING FORMS OF LEAVES, BRACTS, AND BOLLS

(Natural size)

productive varieties in Texas usually are much less important than the differences in quality of staple and the premiums that are obtainable for Acala under normal market conditions.

TYPE SELECTION OF ACALA COTTON

A special system of selection is being applied to maintain the uniformity and productiveness of Acala cotton. The system is different from what is known as mass selection, the saving of good plants and rejection of inferior plants. Although it is undoubtedly possible through mass selection to raise the average quality, a condition of uniformity is not likely to be attained. Plants that appear to be very good may be quite different, and the crossing of different individuals produces diverse offspring, especially in the second or later generations.

In the system of type selection all deviations from the recognized type of the variety are avoided. On account of the effects of conditions of growth, the type that is recognized in a particular district may not correspond to what would be considered as ideal in another district, but the best form as shown by the representatives of the variety under the local field conditions. The typical plants to be preserved for maintaining a uniform seed stock are those that have not deviated from the variety nor fallen below the standard of productiveness and quality.

Account must be taken of the range of variation that is possible in plants of the same select type when grown under different conditions. Not only may the size of the plants be affected by the growth conditions, but all of the characters may be modified to a greater or less extent, as by different soils in the same locality, or by the different quantities of water that may be applied in an irrigated district. The general form or habit of the plants, the manner of branching, the shape and lobing of the leaves and involucral bracts, the size, outline surface texture, and number of locks in the bolls, the number of seeds in the locks, the size of the seeds, and the length, abundance, and character of the lint and fuzz are some of the characters that are subject to change by the external conditions.

On account of the wide range of environmental variation in cotton, it is not a simple matter to recognize the varieties or to hold the selection of a variety definitely to the same type under the various conditions where the stock may be grown.

If any appreciable deviation is shown in any of the characters of the plant, seed, or lint, the individual is rejected, or if the seed is saved it is not planted in a progeny block but grown separately as a selection. Most of the plants that are recognized as definite deviations from the type of a variety are obviously inferior, and many are sterile. Many such selections have been made in the Acala cotton, but no other type has been found superior for general planting purposes to that now in use. Several of the special selections have appeared promising at first, but repeated trials have shown defects or lack of resistance to adverse conditions. There can be no doubt of the need of caution in any change of type, and of careful testing of any new form under a wide range of conditions before its value for purposes of production can be considered as definitely established.

DIVERSITY IN ACALA COTTON

On account of richer soil, more abundant moisture, or wider spacing. cotton plants may grow much larger in some fields than in others, or such differences may be shown in parts of the same field if the soil is uneven or is watered irregularly. But even where the conditions are uniform, some plants may be found that are definitely off-type variations, away from the normal form of the variety. Differences may be shown in the habits of branching, the lengths of the internodes, the size and shape of the leaves or of the involucral bracts, and in the boll and seed characters. Some of the rogue plants are short-linted, small-bolled, or unproductive, sometimes even to the extent of being completely sterile, and others may yield well and appear only slightly different from their neighbors. The process of roguing or pulling out the off-type plants depends on the ability to recognize the true type and to detect the deviations. Roguing is not to make the variety better, but to keep the seed stocks from deterioration. Obviously, it is as important to maintain a variety that is being used for production as to breed or discover the superior type in the first place.

The most frequent and readily observed differences in Acala plants are those that result from the tendency to " cluster " (shortening of the joints of the fruiting branches). This cluster tendency the Acala shares with most of the other types of upland cotton that have been selected for productiveness. As with other varieties, the extent of clustering and the frequency of cluster plants in the fields may differ so greatly with the conditions that the impurity of a seed stock can not be determined from this character alone.

Although many of the cluster plants appear to be very productive and desirable forms, all such plants are removed where careful selection or roguing is done. Many attempts have been made to establish superior varieties with the cluster habit, but so far without success. Some have had a temporary popularity from advertising, but have dropped out of use. Though very high yields may be obtained from such varieties under sufficiently favorable conditions, the cluster plants and varieties are more susceptible to shedding or blasting of their buds or young bolls where adverse conditions are encountered, so that many of the plants may become sterile. It appears also that the clustering tends to increase in successive generations, so that in cluster varieties some of the extreme plants may be nearly or quite sterile, even under favorable conditions (*8*, *15*).

Pronounced changes of characters, including small bolls, short fiber, and slick seeds, have appeared in many fields of Acala and other upland cottons in the Salt River Valley of Arizona, as already stated. On account of the diversity produced by crazy top, the existence of such a disorder must be taken into account in relation to the selection of seed stocks, since many of the abnormal plants might be mistaken for rogues.

The characters of the bolls are important in the recognition of diversity, though care and experience are required to avoid being misled by merely accidental or fluctuating differences. The range of forms on the same plant is often very wide, the bolls with five locks being notably broader in outline than those with four locks. It is a common mistake of those who are not familiar with the cotton plant to suppose that four-locked and five-locked bolls represent different varieties and that plants with both forms of bolls are a result of mixing the seed of different varieties. In reality there are four-locked and five-locked bolls in all of the upland varieties, and usually both forms of bolls can be found on every plant.

The bolls of the cluster variations of Acala commonly are shorter and broader than those of adjacent normal individuals, and often the broader bolls show distinct grooves or folds at the tips, along the sutures between the carpels. These "split-nose" bolls with partly open sutures are to be recognized as a deformity, comparable to the harelip defect in animals. The tendency to open sutures, as well as the cluster tendency, should be carefully avoided in the selection of superior plants to maintain the seed stocks of Acala or of other varieties.

The open sutures render such bolls more accessible to fungi and bacteria, and in some localities serious losses may result from mildew or rotting that begins at the tip of the boll. Such deformities of the bolls are not confined to Acala cotton, but are even more common in Lone Star and other varieties. Plantings of Lone Star and Acala at Manchester, N. C., near Fayetteville, have shown large numbers of bolls with open sutures, and these are often accompanied by rounded protuberances at the base of the bolls, alternating with the carpels. (Pl. 10.)

A NARROW-LEAF SELECTION OF ACALA COTTON

A form of Acala cotton with very narrow, open foliage is attracting special attention in New Mexico as a result of several experiments which indicated an earlier opening of the bolls under high-altitude conditions. (Pl. 11.) Prompt opening is important in the high altitudes or under short-season conditions. An early freeze may destroy the crop, or cool weather may keep the bolls from opening.

The narrow-leaved stock of Acala was developed by H. G. McKeever from a peculiar narrow-leaved plant that was recognized and separated at San Antonio, Tex., in 1914, by Rowland M. Meade. Most of the breeding work with this stock was carried on at Greenville, Tex. In 1922 seed was taken to California and planted in an isolated field in the Coachella Valley, but it seemed to be poorly adapted to conditions there. Much better results were obtained in plantings that were made in the San Joaquin Valley in 1922 and 1923, but no advantage over the normal broadleaf type of Acala was shown in that district. Plantings in some of the cooler valleys have shown differences of yields in favor of the broadleaf type. In a test that was made near Escondido, San Diego County, in 1925, 8 of 11 comparisons of block sections were in favor of the narrow-leaf type. A few miles away at El Cajon the narrow-leaf Acala had opened nearly twice as many bolls by the end of October, though the broadleaf Acala yielded more cotton when the crop was gathered in January, 1926.

The earlier opening of the bolls of the narrow-leaved plants may be connected with the fact that the sparse foliage casts much less shade. Hence, in fields of narrow-leaf Acala the soil may be warmer and the air drier, so that the conditions are more favorable for prompt opening of the bolls. In fields of the usual broad-leaved cottons, more of the ground surface is shaded, and the bolls have less exposure to the sun. In several comparisons it has been found that larger numbers of bolls opened before frost in rows of narrow-leaf Acala than in adjacent rows of the normal broadleaf plants.

If the indications of earlier openings under short-season conditions are confirmed in future seasons, it may be expected that the narrow-leaf selection of Acala will be used in the higher valleys of New Mexico and possibly in other districts. A new cotton-growing community in the Los Lunas district of New Mexico at an altitude of nearly 5,000 feet is undertaking to grow the narrow-leaf variety exclusively and to establish a supply of pure seed for other high-altitude districts.

Except for special short-season conditions, as at high altitudes, there is no reason to suppose that the narrow-leaf strain has any advantage over the normal broadleaf type of Acala. Indeed it has appeared distinctly less desirable in some parts of California, on account of a deficiency of pollen. Under extreme conditions of heat and dryness, the open habit apparently is not an advantage to the plants. From plantings that were made in southern Texas with seed from California it is reported that the poisoning of the boll weevil is more easily accomplished with the narrow-leaf Acala, but no adequate tests of the weevil-control possibilities have been made.

It was recognized as a possible advantage of a narrow-leaf plant that the boll weevils would have less protection from the open foliage and that more of the weevil larvae might be killed in the fallen squares lying on the ground, but it did not appear that the narrow-leaf stocks were more productive in any of the experiments made in Texas or in North Carolina and South Carolina. Block comparisons with the broadleaf type of Acala at Manchester, N. C., and at James Island, S. C., in 1924 and 1925, showed somewhat lower yields for the narrow-leaf type.

GINNING PRECAUTIONS WITH ACALA COTTON

The need of precautions in ginning is being recognized in several Acala districts, in order to obtain good grades and full premiums for better staple. If good ginning is not provided, other improvements of production in organized communities, such as growing better varieties and keeping the seed pure, will not bring the full advantage to the farmer. Careless or incompetent ginning is a frequent cause of impairment of values, often to the extent of 2 or 3 cents a pound, in the loss of premiums that otherwise might be obtained. To get the same grades more care is necessary in the ginning of the longer staples than with ordinary short staples.

It was shown by an investigation of the ginning of Pima cotton in Arizona that the failure of the gins to do regular, uniform work had interfered seriously with the marketing of the crop at full value and discouraged the use of the cotton by some of the manufacturers. Thus the value of the cotton of an entire community may be impaired through poor work on the part of some of the ginners, which gives cotton from that district a bad reputation.

Probably the most general cause of bad ginning of upland cotton like Acala is the notion that a high turnout at the gin is the chief object to be attained. Where cotton is sold with no discrimination of quality and price the gin turnout may be the only factor that seems important to the farmer, and ginners who show the highest percentages of lint may attract the most customers. The farmers in some communities may be more to blame than the ginners, in demanding a very high turnout, which the ginner can supply only by " skinning the seed " to get the very short lint and fuzz or by failing to clean out the motes and trash which the gin should separate from the fiber. Running such materials into the bale is essentially an adulteration of the fiber. The producer of good cotton stands to lose much more in grades and premiums than he can gain from high turnouts. For a 2 per cent increase in weight a 10 per cent premium may be sacrificed.

It is recognized in some of the Acala communities in California that a very high turnout at the gin is practically incompatible with a high grade. If a farmer's gin tickets show that he has had the seed "skinned " to get a high turnout, buyers of good grades refuse his cotton. Some of the ginning establishments have their machinery adjusted to give the farmer " grade " or " turnout " as he orders, while other ginners are refusing to do any more seed skinning, in the belief that this policy will attract and hold more customers.

One of the precautions needed for good ginning of Acala cotton is to run the saws at moderate speed, not more than 400 revolutions per minute on brush gins and 500 revolutions on air-blast gins. The operation of gins at moderate speed is found to be more economical as well as allowing better work to be done. Ginning with a loose roll is even more important than reducing the speed, to avoid gin cutting and the grinding or abrasion of the seeds. If the cotton is damp, such injuries are greatly increased, and good ginning is impossible. Instead of taking wet cotton to the gin, it should be dried in the sun or in a well-ventilated place.

ESTABLISHING SEED SUPPLIES

The precautions that are necessary in establishing supplies of pure seed have been stated in Farmers' Bulletin 1384 (*11, pp. 12–20*). No doubt many problems remain to be solved in developing pure-seed communities, but experience is gained in each undertaking, as the essential requirements become better understood.

The main purpose to be recognized is that the community is attempting to establish a regular and permanent supply of pure seed for producing a better and more uniform fiber that can be sold at a higher price in the market. A further advantage may be gained by selling any surplus of pure seed outside the community, but this should not be confused or allowed to conflict with a recognition of the need of regular supplies for local use by all the cotton growers of the community. Until the local supply of seed is provided and used, the essential conditions of community production are not established. That immediate profits from the seed are to be made by raising a small quantity of pure seed and selling it at a high price is a mistaken idea that must be avoided, because it will interfere with the development of a practical undertaking by the community.

It should not be supposed that farmers will be willing to buy local seed at high prices, or that they can be forced to do so. The community interest requires that the seed for local planting be supplied without profit and at the least possible expense. It may be accepted as a principle in the organization of pure-seed communities, that seed must be available to all of the local growers at the oil-mill prices plus the necessary handling costs. No object is gained if the community tries to make profits out of itself or if a part of the community tries to make profits out of the remainder. Such efforts have failed in the past and seem likely to fail in the future, since the whole community must unite for the success of the undertaking.

The cost of handling the planting seed in the community will vary, of course, with the local conditions and the methods used, though the principle of handling at cost can still be applied. In order to hold adequate stocks of planting seed, which otherwise may be sent to the oil mill, it may be necessary to arrange some form of purchase or advance payment for the seed at the time of ginning. Farmers who raise the select stocks of seed should not be placed at a disadvantage as compared with their neighbors and may need to get prompt returns, since ginning charges are often met by selling seed at the gin. If the community organization borrows money for such purposes, interest must be paid, as well as the charges for sacking, storage, and insurance. To advance the ginning costs and meet other expenses involved in holding the seed for planting, an investment of $25 or more per ton is necessary, as has been shown by experience in handling the Acala seed stocks in the Coachella Valley.

The financial liabilities are increased with the holding of more seed than the community requires for its own planting. In order to hold seed for sale in other districts, a community organization assumes the same risks as a commercial seed business. The handling and holding charges are lost on any surplus seed that is not sold, and the danger of such losses is a serious limiting factor in making good seed widely available. Unless pure-seed communities find it possible to get orders in advance to justify the holding of the seed they can not be expected to keep large stocks of seed in storage, though reasonable reserves should be carried for replanting or other emergencies.

As a basis for assuming the responsibility for the supplies of Acala seed in the Coachella Valley, the Cotton Growers Association has a five-year contract with its members for marketing all the planting seed through the association. Without such a contract to give permanence to the association, there would have been no good reason for the effort that the local leaders and officers of the association have made to develop a practical system of handling the seed supplies.

Since 1921 the Acala Cotton Growers Association of the Coachella Valley has supplied all the seed for local planting at cost and has distributed about 2,000 tons of Acala seed, which has made it possible to extend the variety to other districts of California, Arizona, and New Mexico. (Pl. 8.)

Special cooperation has been given by the United States Department of Agriculture since 1920 in the work of establishing the pure-seed stocks of Acala cotton in the Coachella Valley. The farmers of that district were the first to organize for the definite purpose of establishing a one-variety community, and the district was completely isolated from other cotton-growing regions, so that there was less danger of mixing the seed or crossing with other varieties. Thus there were better conditions for community cooperation and for developing and maintaining a supply of pure seed than in any other district, and these conditions have been maintained to the present time.

The advantages of the one-variety plan became so well recognized that a special act was passed by the Legislature of California to protect and encourage the establishment of one-variety communities in several districts. This makes it possible to increase the supplies of pure seed to a much greater extent than could be done in the limited area of the Coachella Valley alone. If the same precautions are used in the other districts, large quantities of pure Acala seed will be available in California that other cotton-growing regions may draw upon. Thus the use of the variety may not be restricted in the future, as it has been in the past, by the lack of seed supplies (*2*, *12*).

SUMMARY

The Acala cotton is a superior upland type discovered by the United States Department of Agriculture in southern Mexico in 1906, acclimatized in Texas, and established in cultivation, especially in the Southwestern States. The Acala variety now forms the bulk of the crop in the irrigated districts of western Texas, New Mexico, Arizona, and California. Communities have been formed in which no other varieties are grown and in which stocks of pure seed are maintained.

The variety is adapted to a wide range of conditions, including all of the principal regions of production in the United States. On account of its ability to produce good crops in short periods, the Acala cotton is suited to weevil-infested regions as well as to the short seasons along the northern rim of the Cotton Belt. Acala cotton was grown extensively for several years in northern Texas, Oklahoma, and Arkansas, with excellent results, but the seed stocks were allowed to deteriorate and the value of the variety was not generally appreciated.

The Acala is one of the earliest and most prolific varieties of the upland type of cotton, and in many comparisons has given the highest yields, as well as producing better and longer fiber, than other large-bolled varieties. The fiber is abundant and of even length on the seeds, and the staple is 1⅛ to 1$\frac{3}{16}$ inches, under favorable conditions of growth.

The upright habit of the Acala plants gives an advantage over the more spreading habit of the Texas big-boll varieties and makes it easier to keep open lanes between the rows. In the eastern Cotton Belt open spaces between the rows afford better weevil control, since the fallen squares are more likely to be dried out by the hot sun, which kills the weevil larvae. The stronger stalks and more upright habit of Acala also reduce the danger of lodging of the plants, so that picking is easier and fewer bolls are rotted by lying on the ground.

Experience shows that no regular utilization of a superior variety of cotton is to be expected unless stocks of pure seed are maintained, and that no extensive production of pure seed is possible except in communities where only one variety of cotton is grown. Accordingly, it is urged that efforts to utilize the Acala cotton be directed first to the need of establishing one-variety communities where supplies of pure seed can be developed and maintained.

In the Coachella Valley of southern California organized community production of the Acala cotton has been maintained since 1920 on a basis of five-year contracts under which all of the planting seed is handled through an association of cotton growers. Several other valleys have adopted the community plan and are growing Acala cotton exclusively. The one-variety communities in California now have the protection of a special act of the Legislature of California that established pure-seed districts for Acala cotton and made it unlawful to interfere with the production of Acala by planting other varieties.

On account of the superior quality and length of the fiber there is an active demand for Acala cotton at higher prices than for short staples. Premiums of about 5 cents a pound, ranging from 2 to 10 cents a pound, are obtained for Acala cotton in communities that restrict themselves to the growing of this variety. Better market contacts are established because commercial quantities of uniform fiber are produced. Cooperative marketing is facilitated and rendered less expensive in communities that have a standardized production of one variety.

The one-variety communities in the irrigated valleys make it possible to produce the large supplies of pure seed which are needed for a wider utilization of the variety, not only in the southwestern districts but in other parts of the Cotton Belt. It is not to be expected that the variety can be established and maintained in other producing regions without a regular provision for supplies of good seed.

One of the difficulties of maintaining seed stocks under eastern conditions is the occurrence of local crop failures on account of bad weather or heavy weevil damage, which may affect whole districts where the seed stocks of good varieties are centered. Such losses of seed stocks result in a serious deterioration of the crop unless good seed can be obtained from other regions where the crop did not suffer. For meeting such emergencies the seed stocks of Acala cotton in the southwestern valleys may be of great value to the eastern Cotton Belt.

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30

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